GASGUARD

Programmable Intrinsically Safe Controller

INSTALLATION, OPERATION & MAINTENANCE MANUAL

Revision 2

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Designed and Manufactured in Australia by Ampcontrol CSM Pty Limited.

AMPCONTROL®

Safety and other Warnings

WARNING! 	**Identifies important safety messages contained within this manual. These messages highlight potential risks, the occurrence of which may result in serious injury or death to personnel. When you see this symbol, pay close attention to the message that follows, understand its meaning and ensure other operators are made aware of the risk.**

CAUTION! 	**Identifies important technical information contained within this manual. Information of this type provides instruction or guidance that will help ensure safe installation, operation and maintenance of the Controller. This information must be understood and applied in order to reduce the possibility of injury to personnel. Correct application of these instructions will also reduce the possibility of damage to the Controller and/or other connected equipment.**

	**Supplementary information not directly affecting safety or integrity of the equipment.**

	**Information concerning possible impact on the environment, along with actions required to reduce environmental risk.**

Applying This User Manual

The contents of this user manual relate to the full range of Gasguard Sensor Controllers, across a number of system firmware revisions. The following list covers the differences between Controller versions and the features described by this Manual.

For all Controller types loaded with system firmware **V2.7-09-2011 and above**, all of the functional descriptions covered in this Manual are applicable.

For all Controller types fitted with system firmware **prior to V2.7-09-2011**, the following functional descriptions do NOT apply since these functions are not present within the Controller :-

[i] Relay start-up behaviour (section 2.9.1)

[ii] Relay start-up latch function and configuration (sections 2.9.1 and 4.4.5)

[iii] Enabling / Disabling of alarm reset via the left navigation key (section 2.8 'Resetting Alarms')

[iv] Supply voltage measurment value available within the Modbus register set (section 10.1.3 address 30013)

[v] Memory check failure notification (section 6.2.1)

Copyright Notice

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Ampcontrol further reserves the right to alter the specification of the system and/or manual without obligation to notify any person or organisation of these changes.

Before You Begin

WARNING! 	**To minimise the possibility of unsafe operation of this equipment, the user must be competent, via appropriate training, in regards to international standards and safety requirements relating to its installation, operation and maintenance. Safety related Information contained within this manual is supplementary to such standards, but must be equally understood and applied to both maximise safe use of this equipment and minimise risk to persons or other equipment.**

We would like to take a moment to thank you for purchasing the Gasguard IS Controller.

Gasguard Controller Certification Information

The Gasguard Controller is certified for use in underground hazardous area applications and carries the following certification and marking.

Type of Protection: **Exia**

Marking: **Ex ia I**

Certificate No.: **IECExITA07.0003X**

For conditions of safe use, see the certificate of conformity at the end of this manual.

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1. Receiving and Storage

1.1 Receiving

All possible precautions are taken to protect the Gasguard controller against damage or losses during shipment, however before accepting delivery, check all items against the packing list or Bill of Lading. If there are shortages or evidence of physical damage, notify Ampcontrol immediately.

Notify Ampcontrol within 7 days (maximum) in case of shortages or discrepancies, according to the packing list. This action will help ensure a speedy resolution to any perceived problems. Keep a record of all claims and correspondence. Photographs are recommended.

Where practicable do not remove protective covers prior to installation unless there are indications of damage. Boxes opened for inspection and inventory should be carefully repacked to ensure protection of the contents or else the parts should be packaged and stored in a safe place. Examine all packing boxes, wrappings and covers for items attached to them, especially if the wrappings are to be discarded.

1.2 Storage after Delivery

Where equipment is not to be installed immediately, proper storage is important to ensure protection of equipment and validity of warranty.

All equipment should be stored indoors protected from the elements in a cool dry area. If storing on the ground, ensure that the storage area is not an area where water will collect.

1.3 Unpacking of Equipment

The method of packing used will depend on the size and quantity of the equipment.

Take care when unpacking the Controller to avoid damaging its enclosure or display window.

 ENVIRONMENTAL ALERT	The disposal of packaging materials, replaced parts, or components must comply with environmental restrictions without polluting the soil, air or water. Ensure that any timber and cardboard used as packaging is disposed of in a safe and environmentally responsible manner. Where possible, dispose of all waste products i.e. oils, metals, plastic and rubber products by using an approved recycling service centre.

2 General Safety

2.1 Personnel Safety Warnings

2.1.1 Relevant Personnel

Ensure all personnel directly responsible or involved with the installation, operation and maintenance of the equipment reference this manual in conjunction with information contained within any risk assessments conducted to identify risks and hazards.

2.1.2 Safety Communication

All safety instructions and design requirements within this manual must be communicated to all users. These requirements are necessary to identify and control any foreseeable risk associated with this piece of equipment. In the event of any damage or malfunction that results in the potential to harm the health or safety of any person; the owner/operator should notify the manufacturer immediately.

2.2 Safe Use of Equipment

This equipment has been manufactured in accordance with quality standard OD005 to ensure compliance to its certificate of conformity. If there are any signs of modification or damage to this equipment, it must not be used until it has been repaired and deemed fit for purpose by the equipment's manufacturer or by an AS3800 accredited workshop.

The instructions within this manual must be implemented as an aid towards achieving safe operation.

2.2.1 Intended Use of the Equipment

The Gasguard Programmable Intrinsically Safe Controller is designed to operate with a variety of Group I hazardous area certified gas detectors and offer versatility of sensor management and data acquisition. The controller is used to connect to a system that is responsible for activating ventilation and/or alarm systems. to reduce the probability of potentially harmful situations. The Gasguard Controller is specifically intended for Group I mining applications.

2.2.2 Changes to Equipment

Changes in the design and modifications to the equipment are not permitted.
Unauthorised changes made to the Controller hardware or operating firmware will void the manufacturer's warranty, and may compromise the conditions of certification, the integrity of the system into which it is installed and other connected equipment.

2.2.3 Equipment Knowledge

Experience with, or understanding of, this equipment is essential for the safe installation and removal of the equipment. If in doubt, contact Ampcontrol.

Mechanical and or Electrical installation, and maintenance of plant and equipment, must only be carried out by appropriately trained, qualified technical personnel.

2.3 Operational Restrictions and Limitations

The operational restrictions listed below must be understood before considering using the Gasguard controller within systems designed to ensure the safety of personnel. Using the Controller in a manner that exceeds its electrical, functional or physical specifications, or in a way that is contrary to its operating restrictions, may create risks to personnel and/or equipment resulting in injury or death.

The Gasguard Controller is designed to operate as part of a Safety Instrumented System, alongside other equipment that collectively form the means to minimise the risk of injury or death to personnel.

- **The selection, installation, commissioning and use of this protective device should only be undertaken following the application of a detailed risk assessment that is consistent with the methodology outlined in AS/NZS ISO 31000 risk management. Additionally, identified risk control measures identified within the risk assessment additional to safety controls and/or directions contained within the products operating manual must be validated as effective before use of the product in any capacity.**
- **The Gasguard controller is NOT designed to be used as the sole means of ensuring safety to personnel or equipment.**
- **The Gasguard controller does NOT have an associated Safe Failure Fraction (SFF).**
- **The Gasguard controller is NOT certified for use in Group II hazardous area applications**
- **The Gasguard controller is NOT to be considered as a PLC since the device does not support full logic decoding of input alarm conditions and output relay actions.**
- **The Gasguard controller is NOT water resistant and must be mounted within a suitably IP rated enclosure for use where the overall system is to be rated water resistant**
- **The Gasguard controller is NOT on-site repairable and contains no user serviceable parts.**
- **The Gasguard controller must NOT be modified in any way. A controller that differs in any way from its 'as-certified' condition must not be used.**
- **A Gasguard controller showing any visible signs of damage must not be used.**
- **Sensors and Power Supply connected to the Gasguard controller must comply with the requirement of I.S. configuration.**
- **Cleaning the controller may create an electrostatic hazard. Anti-static cleaning media must be used.**

2.4 Conditions of Conformity – Ex ia

WARNING! 	**To comply with the Conditions of Certification, ensure full serviceable life of the product, and avoid nullifying the warranty, it is essential to exercise great care with the installation, use and storage of the System components. Failure to comply with the Conditions of Certification (Appendix C – Approvals) may seriously compromise the integrity of the system and/or its components, and the consequence could be fatal. The user must ensure that the "Conditions of Safe Use" outlined in the certificate are met or the certificate (and the IS rating) will not be valid.**

2.5 Overview of the Gasguard Controller

2.5.1 Basic Description

The Gasguard Programmable Intrinsically Safe controller (Controller) produced by Ampcontrol is designed to operate with a variety of hazardous area certified gas detectors. Compatible detectors are presently supplied by Ampcontrol and other manufacturers.

The Controller is supplied with either two or four programmable input channels (see Parts List in Section 8 of this Manual for details).

Input channels may be supplied to operate with a 4-20mA current input signal or a 0.4 - 2.0V voltage input signal. This configuration is fixed by the manufacturer and is not user modifiable.

Each input channel is independent of the others and can be configured on a 'per-channel' basis allowing flexible system configuration.

2.5.2 Input channels are user configurable, and may be:-

- Set to be ON or OFF.
- Given a name to represent its function.
- Selected to display one of a number of gas types.
- Configured to display one of a number of measurement units.
- Configured to display from none to two decimal places.
- Scaled to a user defined maximum value, ranging from zero 9999.

Each input channel has three programmable 'set-points' which can be set to trip based on the signal input level.

2.5.3 Each set point may be:-

- Set to operate at a specific channel input level.
- Set to operate with hysteresis.
- Set to operate in a particular direction (rising signal or falling signal).
- Operate immediately or after a user configured delay.
- Set to latch an alarm indication or auto-reset.

In addition to the input based set-points, there are two 'fault' set-points. These set-points are referred to as High-Fault and Low-Fault.

2.5.4 High and Low Fault set-points may be:-

- Set to operate at a specific channel input level.
- Set to operate on a rising or falling input signal.

The controller has four relay outputs, mappable to alarm set-point from any channel.

2.5.5 Each of the four relays can be set to:-

- Latch. This feature may be used to preserve a record of a relay's state in the event of a power failure or to record an alarm event where there may be no one to respond to it at the time it occurs.
- Be normally energised or normally de-energised.

. The Controller has six alarm 'zones' that allow grouping of input channel set-points and output relays.

2.5.6 Each zone may be configured to:-

- Include a specific or multiple set-point(s) from a specific input channel.
- Include multiple set-points from multiple input channels.
- Include from zero to four of the output relays.

2.5.7 Analogue Outputs

The Controller has three 4-20 mA current repeater outputs to drive remote displays or PLC/SCADA Systems.

The analogue outputs may be set to one of the following modes :-

- Follow a particular channel.
- Follow the highest reading from a number of selected channels.
- Follow the lowest reading from a number of selected channels.

During the start-up delay time when power is applied to the Controller, the follower outputs are active and will pass on whatever input signal current is present via assigned channels.

The Controller is DIN rail compatible and has been approved to be intrinsically safe for use in a Zone 0 hazardous area. The Controller must be powered from an Intrinsically Safe power supply with a maximum output of 16.5V.
The Controller is designed to operate with a minimum supply voltage of 12V dc.

A two line Liquid Crystal Display (LCD) combined with a keypad provides an intuitive user interface, providing easy access and rapid adjustment to all controller settings.

CAUTION!	**The user is responsible for maintaining the Ex ia Intrinsic Safety rating by complying with the "List of Special Conditions" outlined in the certificate (Appendix C – Approvals).**

2.6 Understanding Gasguard Controller Functionality

The Controller's operation can be modified via changes to its configuration settings. Configuration changes must therefore be carried out with an understanding of the Controller's functional specifications, its limitations and the effect that configuration changes may have on the system into which it is installed.

Refer to the Controller functional diagrams in Appendix A of this manual.

These diagrams show:-

- Top level block diagram showing connectivity of each Controller section
- Input Channel block showing signal path and user configurable settings.
- Zone block showing alarm routing and user configurable settings
- Relay block showing trigger sources and user configurable settings.

2.6.1 Controller Layout.

With reference to the top level block diagram, the controller is arranged as four input blocks, six zone blocks and four relay blocks. The basic Controller operation is best understood by becoming familiar with the workings of the 'Zone Block'. Zone Blocks are essentially the core of the Controllers input-to-output 'logic' functionality.
All six Zone Blocks may be configured to share the same alarm set-point signals and relays. Each configured and enabled Zone Block will be simultaneously operational, creating relay events based on alarm set-point status, included relays and vote count.

2.6.2 Adding Input Alarm set-points to a Zone Block (Refer to Zone Functional Diagram in appendix A)

A Zone Block groups together alarm set-point signals and 'maps' them to selected relays. A Zone Block input can be any or all of the alarm set-point signals from any/all input channel (a max. total of 20 set-points). A set-point can be configured to be included or not included in a Zone Block's input. Included alarm set-point signals are effectively 'OR'ed' together, such that any active set-point may *potentially* operate a relay.

Note: A set-point, even if active, is ignored if it is not included in a Zone Block input.

2.6.3 Adding Relays to Zone Blocks (Refer to Relay Functional Diagram in appendix A)

Any or all of the four relays may be included in a Zone Block's output. Including a relay into a Zone Block output, maps it to the selected alarm set-points at the Zone Block's input. A relay may be included in any one, or all of the six Zone Blocks simultaneously.

Note: ***If there are no relays selected in any of the six Zone Blocks, then the Controller will not indicate alarm states via the relays.***

A relay may be set to be 'ON' or 'OFF'. If a relay is set to 'OFF' it cannot be activated irrespective of other settings within the relay configuration menu, or via any conditions set within a Zone Block.
Relays may be set to be on, off, in or out of a Zone Block via the relay configuration menu.

2.6.4 Zone Voting

The Zone Voting function allows the operator to select the number of active, included set-points that are required to activate an included relay. In total there are up to 20 alarm set-points that can be included in a Zone Block's input, and accordingly, the vote number can be set from 1 to 20.

Note: ***The vote count value is important since it controls the logical behaviour of the included relay.***

If a vote count of 1 is set, then the set-point signals are effectively 'OR'ed' together and **any** included set-point will potentially activate the included relay.
If the vote count is set equal to the number of included set-points, then the logic effectively becomes an 'AND' function. Under this condition a relay will only be activated when the number of active set-points is equal to, or greater than the vote count. Single set-points becoming active, or multiple active set-points below the vote count will not activate an included relay.
The vote count does not allow for specific set-points to be included in the number that must be active. Any set-point from any channel will be considered in the comparison. For example, if 12 set-points are included and the vote count is set to 5, any 5 of the 12 set-points will potentially activate an included relay.

2.6.5 Zone Active Status

A Zone Block may be set to be inactive, irrespective of included set-points and relays. A Zone block that is set to 'OFF' will not allow its included relay to be activated via the included input set-points. A relay included in a Zone Block that is set to 'OFF' may still be activated if it is included in another Zone Block that is set to 'ON'.

Example Settings for a Zone Block (Refer to Section 4 for nomenclature relating to Controller settings).

Alarm Set-Point inclusion is made in the Zone configuration menu.
Relay inclusion is set via the Relay configuration menu.

Example 1:
Assume set-points and relay inclusions not shown, to be set as [NOT IN].

RELAY 1:
Status [ON]
Zn1 [IN] Allocate Relay 1 to Zone Block 1.
ZONE 1:
Status [ON]
Ch1 LF [IN] (include Chan 1 Low Fault set-point).
Voting [1] (only a single set-point needs to be active to activate the relay).

For the above settings, Relay 1 will become active when there is a Low Fault on channel 1.

Example 2: Inclusion of multiple set-points across multiple channels (vote = set-points).

Assume set-points and relay inclusions not shown, to be set as [NOT IN].

RELAY 1:
Status [ON]
Zn1 [IN] Allocate Relay 1 to Zone Block 1.
ZONE 1:
Status [ON]
Ch1 A1 [IN] (include Chan 1 A1 set-point)
Ch2 A1 [IN] (include Chan 2 A1 set-point)
Ch4 A3 [IN] (include Chan 4 A3 set-point)
Voting [3]

Relay 1 will become active when:- Ch1 A1 is active **AND** CH2 A1 is active **AND** Ch4 A3 is active.

Example 3: Inclusion of multiple set-points across multiple channels (vote = 1).

Assume set-points and relay inclusions not shown, to be set as [NOT IN].

RELAY 1:
Status [ON]
Zn1 [IN] Allocate Relay 1 to Zone Block 1.
ZONE 1:
Status [ON]
Ch1 A1 [IN] (include Chan 1 A1 set-point)
Ch2 A1 [IN] (include Chan 2 A1 set-point)
Ch4 A3 [IN] (include Chan 4 A3 set-point)
Voting [1]

Relay 1 will become active when:- Ch1 A1 is active **OR** CH2 A1 is active **OR** Ch4 A3 is active.

Example 4: Inclusion of a relay across two Zone Blocks. Vote counts set to allow basic alarm logic decoding.

Assume set-points and relay inclusions not shown, to be set as [NOT IN].

RELAY 1:
Status [ON]
Zn1 [IN] Allocate Relay 1 to Zone Block 1.
Zn2 [IN] Also allocate Relay 1 to Zone Block 2.
ZONE 1:
Status [ON]
Ch1 A1 [IN] (include Chan 1 A1 set-point)
Ch2 A1 [IN] (include Chan 2 A1 set-point)
Voting [2]
ZONE 2:
Status [ON]
Ch3 A2 [IN] (include Chan 3 A2 set-point)
Voting [1]

Relay 1 will become active when:- Ch1 A1 is active **AND** CH2 A1 is active, **OR** Ch3 A2 is active.

2.6.6 Zone Block Configuration Warnings

The following points must be observed to ensure that the Controller can predictably signal an alarm state via its relays. Failure to observe these points and select appropriate settings may result in alarm indication failure.

- ***Do NOT set a Zone Block Vote Count to a value greater than the number of included alarms. For example, if a Vote Count of 3 is set, but there are only 2 included set-points, the included relay will not become active even if both set-points are active***.

- ***Ensure that the vote count setting is such as to provide the desired logic in relation to active set-points and relay operation (see examples 2 and 3 above)***

- Ensure that a required relay is included in a Zone Block's setting.
- Make sure that all relays included in a Zone Block are set to 'ON'
- Make sure that the Zone Block being configured for use is set to 'ON'
- Multiple Zone Blocks may be configured, each sharing the same set-point signals and relays. It is important to ensure that the use of multiple Zone Blocks with possibly different settings, does not create conflict in triggering relay events.

2.7 Setting Input channel Parameters.

Each of the four input channels may be configured to match the characteristics of the equipment connected to it.

Note: In all cases, the input signal *type* is fixed during manufacture to either:-

- Current input. This input will normally operate over the range 4 – 20mA. Fault levels lie outside this range.
- Voltage input. This input will normally operate over the range 0.4 – 2V. Fault levels lie outside this range.

A channel may be set to operate according to the following:-

Channel Activity
A channel may be set to be active or non-active. Inactive channels provide no process signals or alarm outputs to functions further downstream.

- A non-active channel is displayed as 'OFF'.
- An active channel is displayed as 'ON'.

Gas Name
A channel may be identified by selection of one of six standard types, or a user specified type, namely:-

- CH4 (methane)
- CO (carbon monoxide)
- O2 (oxygen)
- H2S (hydrogen sulphide)
- AV (Air Velocity)
- DP (Differential Pressure
- User (7 character name may be input)

Decimal Point
Each Input channel may have its display reading configured to correctly indicate the process value.
The available settings for decimal places are:-

- **nnnn** (e.g. 2500)
- **nnn** (e.g. 250)
- **nn.n** (e.g. 25.0)
- **n.nn** (e.g. 2.50)

Full Scale Reading
Input process signals to the controller are typically in the range 4 – 20mA and as such may represent a variety of actual process scaling. To set the relationship between 4-20mA input and the process scaling, the channel full scale value may be set. Settings are per digit, with up to four digits available. The displayed value of this setting will depend on the decimal place setting.
The maximum value that may be set is to be **9999** (999 / 99.9 / 9.99 depending on decimal point position)

Units
The process displayed readings can be given units of measurement indicator. There are ten pre-set unit types available for selection, namely:-

- %v/v (percent volume per volume)
- ppm (parts per million)
- LEL (Lower Explosive Limit)
- % (percent)
- V (volts)
- mV (millivolts)
- rpm (revolutions per minute)
- Hz (cycles per second)
- kHz (thousands of cycles per second)
- m/s (meters per second)

Tag
A channel may be given an identification name that provides meaningful representation of its purpose/function within a system. The tag input is entered as a 9 character name consisting of the following characters:-

- Symbols: blank * - + .
- Numeric: 0 – 9
- Alpha A-Z (uppercase only)

The following information should be understood to ensure that the Controller reliably signals alarm states at appropriate levels. Failure to observe correct settings may result in system alarm failure.

2.8 Setting Alarm Set-Points

There are five available alarm set-points per channel, giving a total of 20 alarm signals. The available alarms cover high fault, low fault and three process level alarms. Each channel's alarm group is independent of other channels.

The high and low fault alarms are active for process signals that rise above or drop below the baseline 'zero. The high and low alarm threshold points are set in terms of input milliamps. The high fault and low fault alarms are named 'HF' and 'LF' respectively in the menu system.

The process level alarms, named A1, A2, and A3, are configurable based on the units set for that channel. Each alarm may be set to trip based on an input signal's 'position' relative to the set-point (i.e. input above set-point, or input below set-point).

Note: Alarms that activate above or below a user set threshold are often referred to as 'rising' or 'falling' alarms. For the Gasguard controller, alarms become active only when an input crosses the set threshold. An alarm is not activated by sensing a change in signal direction, or by a rate of change of input signal level.

The following alarm parameters may be set by the user:-

- LF alarm level (in mA, 0 to 99.99)
- HF alarm level (in mA, 0 to 99.99)
- A1 alarm level (in process units, pos/neg value, 0 to value scaled by decimal place setting)
- A2 alarm level (in process units, pos/neg value, 0 to value scaled by decimal place setting)
- A3 alarm level (in process units, pos/neg value, 0 to value scaled by decimal place setting)
- LF alarm direction (Falling / Rising)
- HF alarm direction (Falling / Rising)
- A1 alarm direction (Falling / Rising)
- A2 alarm direction (Falling / Rising)
- A3 alarm direction (Falling / Rising)
- LF alarm latching mode (mask bit, Latch = YES, non-latch = NO)
- HF alarm latching mode (mask bit, Latch = YES, non-latch = NO)
- A1 alarm latching mode (mask bit, Latch = YES, non-latch = NO)
- A2 alarm latching mode (mask bit, Latch = YES, non-latch = NO)
- A3 alarm latching mode (mask bit, Latch = YES, non-latch = NO)
- Alarm Delay (in mS, 0 to 9999). Sets time delay from process input matching set threshold, to alarm signal becoming active. Operates on any/all 5 channel alarms and is not configurable per individual alarm.

Within each channel, an alarm threshold cannot be set that exceeds the full scale for that channel. The controller scales all set-point values according to the full scale setting.

For example, a channel with a full scale reading initially set to 1000 and set-point configured to 500, the set-point is 50% of the scale value.
If the channel full scale value is now changed to 2000, the Controller will automatically rescale the trip-point to 1000. This maintains the trip point at the same proportion of full scale (50% in this example).

When setting alarm set-point thresholds, it is important to ensure that they comply with recognised standards applicable to the application into which the controller is installed. If no standards exist to specify the alarm thresholds, they should be set based on a full understanding of the application by a suitably authorised person or body.

- **Alarm levels should be used in the order of their nomenclature, i.e. the first alarm level is A1, the second is A2 and the third is A3.**

- **An alarm that sits higher in the naming order (A1, A2, A3) should be set to a higher trip threshold than one that sits below it.**

Latching Alarms
If an alarm state could be missed because there is likely to be nobody present to observe an event as it occurs, a latching alarm should be set. A latched alarm will remain active even when the event triggering it is no longer present. If the Controller undergoes a power cycle following the triggering of a latched alarm, the latched status will be re-instated once the Controller has re-booted.

Resetting Alarms
A latched alarm may be manually reset by the use of either the 'LEFT' key held for 5 seconds (only if the left key reset feature is enabled in the configuration settings), or by the remote reset terminals. The Controller configuration allows the left key reset feature to be enabled or disabled. When disabled, only authorised users who know the Controller system passwords are able to change this to an enabled status. If the left key reset is enabled, a latched alarm can be reset by any person whether authorised or not. It is up to the user to control access to and/ or permissions relating to the resetting of latched alarm conditions.

Note: Alarm and relay states are NOT intentionally preserved during the time power is removed from the controller. Alarm and relay states are re-established once power is restored and the Controller has completed its self-test. The interpretation of a relay contact state during a power failure, will depend on how it has been configured to operate.

2.9 Configuring Relay Operation

Each of the four relays within the Controller is a single pole change-over type.

There are three connections associated with each relay, namely 'Common – C', 'Normally Open – NO' and 'Normally Closed – NC'. At any given time, the 'Common' terminal will be connected to either the 'NO' or 'NC' terminal depending on the relay configuration and the logic of the Zone Block driving it.
Relays can be configured to be 'Normally Energised – NE', or 'Normally de-energised – ND' (see below).
The context of 'NC' and 'NO' will change depending on whether a relay coil has been configured to be normally energised or normally de-energised under non-alarm conditions.

2.9.1 Relay Start-Up Conditions

When the Controller powers up it enters a period of self test for a number of seconds. Following this self-test, there may be a further start-up delay if this has been configured by the user. During the self test and start-up delay periods, the relays are held in an 'alarm' condition. The state of each relay is set based on the user configuration for the relay operation. A normally-energised relay (non-alarm state) will sit in the de-energised state during the power up delay period. A normally de-energised relay (non-alarm state) will sit in the energised state during the power up delay period. This start-up behaviour is not user-configurable except for the length of the start-up delay.
Once the delay period has expired, the condition of the relays will depend upon how the relay start-up mode has been defined in the Controller relay configuration. Each relay may independently be set to one of two start-up modes, namely :- [1] LIVE and [2] LATCHED. In Latched mode, a relay will remain latched in the alarm state after the start-up delay has expired. To clear this latched condition, a 'left-key' reset or a remote reset is required.
For relays set to 'LIVE' mode, the relays will assume operation according to the state of the input channel signals and alarm settings once the start-up delay has expired.

2.9.2 Normally De-Energised Relays

A relay set to be 'ND', will, under normal (non-alarm) conditions, have no power applied to its coil. With no power applied to the coil, the 'Common' relay terminal will be connected to the 'NC' terminal (as marked on the terminal label).
When an alarm state exists that is configured to drive an 'ND' relay, power is switched to the coil and the contacts change state. The 'Common' relay terminal will now be connected to the 'NO' terminal. The changing state of the contact signals an alarm condition.

If the Controller is operating with no active alarm conditions, all relays set to 'ND' will be unpowered and inactive. If, during this condition, power is removed from the Controller, there will be no change of state of any of the relay contacts. Relays set to 'ND' cannot signal a fault condition due to power loss. Although the state of the relay contacts is 'preserved' (i.e. not changed) under non-powered conditions, this is not an intentional state preservation, rather it is just an outcome of having normally inactive (unpowered) relays.

2.9.3 Normally Energised Relays

If it is required to signal a fault due to power loss, relays should be configured to 'Normally Energised – NE' operation.

Relays set to 'NE' will have power applied to their coils during the normal (non-alarm) state. Under these conditions, the 'Common' relay terminal will be connected to the 'NO' terminal (as marked on the terminal label). For 'NE' configured relays, the function of the contacts, as marked on the terminal label, is reversed (i.e. 'NO' becomes 'NC' and vice versa).

When an alarm state exists that is configured to drive an 'NE' relay, power is removed from the coil and the contacts change state. The 'Common' relay terminal will now be connected to the 'NC' terminal (as marked on the terminal label). The changing state of the contact signals an alarm condition.

If the Controller is operating with no active alarm conditions, all relays set to 'NE' will be powered. If, during this condition, power is removed from the Controller, there will be a change of state of any of the relay contacts since the coils are no longer being supplied with power. Relays set to 'NE' are therefore able to signal a fault condition due to power loss.

2.9.4 Alarm Set-Point Delays

Under some conditions, it may be desirable to trigger a set-point, only if an alarm condition has existed greater than a certain period of time. This allows transient conditions to occur without triggering an alarm event.
The Controller allows a delay to be set from 0 – 9999mS (9.999 seconds). The delay is common to all 5 trip-points within a channel but each channel may have a different delay.

When setting alarm set-point delays, it is important to ensure that the time set before a relay is triggered, does not create a hazardous situation. Delays must set based on an understanding of their effect on the system into which the controller is fitted.

2.9.5 Alarm Set-Point Hysteresis

Under normal operating conditions, a measured value from a sensor connected to the Controller, may be sat close to the value set as an alarm set-point. For example, a slowly rising gas level may have just reached the set-point threshold. The measured value may briefly cross the set-point threshold and then drop back below it again. If no alarm delay has been set, then an alarm relay may 'chatter' on and off, creating unreliable alarm signals to connected equipment. To overcome this problem, a hysteresis level may be set for each process alarm on each channel. The hysteresis value can be set from 0% to 20% of the channel full scale setting.

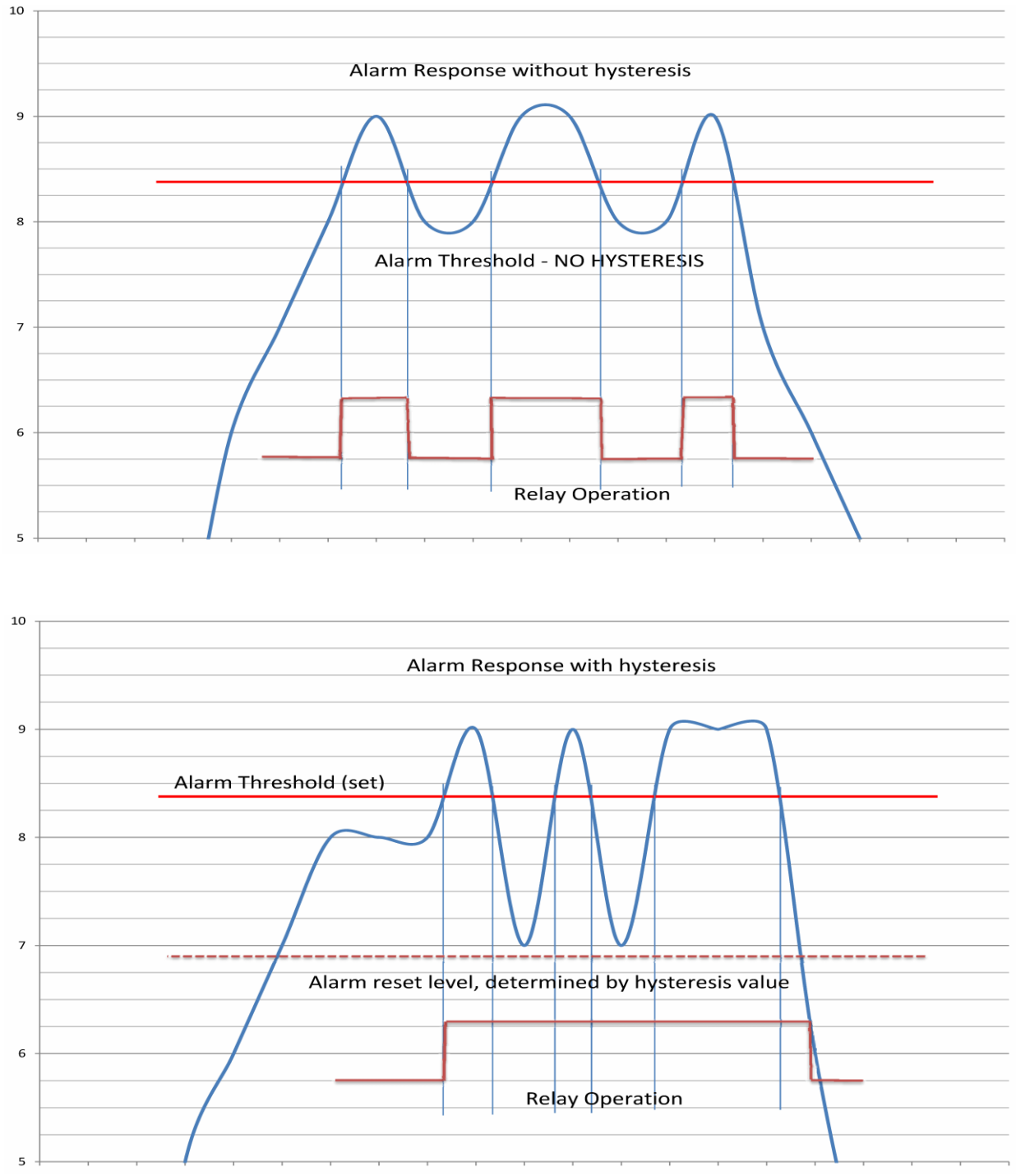


Figure 1: Effect of Setting Alarm Hysteresis.

3 Menu Structure

The Gasguard IS Programmable Controller has two levels of use:

1. Main Menu (user-read only)
2. View and Modify (programmable password protected)

The first level, which is read only, enables the user to view all current settings and real time data without affecting the configuration of the controller.

The second level has the features of the first plus the ability to view and modify the calibration and configuration of the Gasguard Controller.

The default screen is the Monitoring screen. This allows the user to view the actual monitored gas levels; and will display alarms if activated. To view current settings the user must operate the keypad.

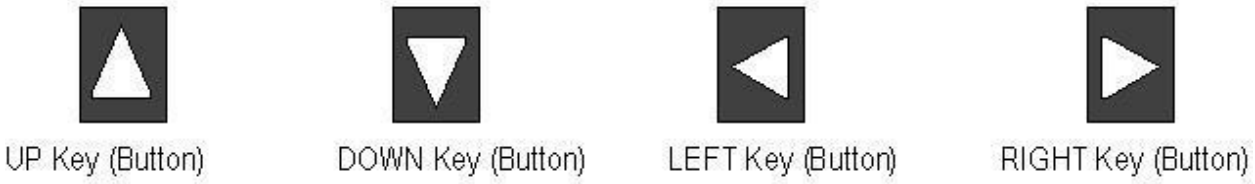
3.1 Key Pad Functions in Main Menu

The facia of the Gasguard IS Controller has a two line 16-character Liquid Crystal Display (LCD), Status LED's and a tactile keypad.

The layout of the display structure is graphically illustrated in Section 5 of this manual – 'Flowcharts'.

Navigation of the menu is performed by pressing the arrow keys on the keypad.

The display level is changed with the Up and Down arrow keys, and the display position is changed with the Left and Right arrow keys.



The Up arrow key and Down arrow key enable the user to scroll through the menu.

The Right arrow key allows the user to view more detailed information about channels, zones, relays, alarms and outputs.

The Left arrow key allows the user to escape from the present screen.

The Alarm Reset function is carried out by holding the Left arrow key for 5 seconds. Any alarm that is below the preset threshold will be reset **(only if the left button reset is enabled in the configuration settings)**.

3.2 Main Menu

The main menu is available from the Monitoring Screen (Default Screen) and offers access to the following seven levels:

1. Channel Information
2. Zone Information
3. Relay information
4. Analogue Information
5. Data Communication Information
6. Calibration (View and Modify)
7. Configuration (View and Modify)

Levels 1 to 5 are read only. The user can operate the keypad, as previously described, to view all current settings.

Level 6 and 7 are view and modify and are password protected. This level enables calibration and/or configuration of all relevant settings, inputs and outputs. This is discussed, in more detail, in Section 4, Programming.

3.3 Controller LED and Display Operation

There are seven Status LED's located on the facia of the IS Controller:

- Power LED - Red
- Alarm LED – Red
- Fault LED – Red

⚠ ***Relay Indication LEDs (x 4). These LEDs do not indicate the presence of power to the relay coils. An illuminated relay LED indicates that a relay has changed state from a non-alarm state into an alarm state.***

On power up, the power LED will activate and the controller will enter its start up procedure. This includes a 10 second long self-test mode that carries out internal tests. Input signal status and alarm states are checked during the start-up sequence.

Once the start up procedure is completed, the Display will show all current gas levels. Alarm, Fault and Relay LED's will reflect the state of the input channel signals/alarm states according to how the Controller has been configured.

There are 3 Alarms and 2 Faults.

- Alarm1 (A1), Alarm2 (A2), Alarm3 (A3)
- Low Fault (LF)
- High Fault (HF)

3.3.1 In the event of an Alarm in non-latched mode:

The alarm LED activates.

The current gas level and alarm type (ALM1, ALM2 or ALM3) toggle on the display.

The relevant relay and LED activates and remains ON.

If the gas level is no longer in an alarm region, the Alarm and relay LEDs turns OFF. The gas level only is displayed.

3.3.2 In the event of an alarm in latched mode:

The alarm LED activates.

The current gas level and alarm type (ALM1, ALM2 or ALM3) toggle on the display.

The relevant relay and LED activate and remain ON

The current gas level and the latched alarm type (ALM1, ALM2 or ALM3)toggle on the display.

The relevant relay and LED is activated and stays ON.

If the gas level is below a latched alarm level but still above another alarm point, the latched alarm can be reset by holding the ◁ key down for 5 seconds or activating the remote reset button. The display will now indicate the next lowest alarm that is active. Other active alarms will not be reset.

OR: If the gas level has dropped into the region below all alarm setpoints but the latched alarm has not been reset, the alarm LED and the latched relay LED remain ON.

The current gas level and highest alarm type (ALM1, ALM2 or ALM3) toggle on the display.

The alarm can be reset by holding the ◁ key down for 5 seconds or by activating the remote reset button. The alarm and relay LEDs turn off and the current gas level is displayed, no alarm flashing.

3.3.3 In the event of a Fault indication:

Once the source of the fault has been identified and celared, proceed in the same way as for an alarm condition.

4 Programming

4.1 Programming Overview

All operating functions of the Gasguard System can be programmed through the keypad on the controller by entering into the Configuration Menu. Note that some keys have more than one function.

4.1.1 Key Pad Functions in Modify Menu

- By using the △ key in the modify menu, the operator can scroll the alpha-numerals or pre-set values.
- By using the▽ key in the modify menu, the operator can move the cursor across to the next digit.
- By using the ▷ key in the modify menu, the operator can save the new settings.
- By using the ◁ key in the modify menu, the operator can escape out of the modify zone, and not save the new settings.

4.1.2 To enter the Configuration Menu:

1. From the Monitoring Screen, press the △ key to scroll up to level 7 'Configuration View and Modify' Menu.
2. Press the ▷ key to enter into the 'Do you want to continue?' screen.
3. If YES, press the ▷ key to gain access; if NO, press the ◁ key to exit.
4. On the 'Enter Password' screen, use the △ key to scroll through the numbers.
5. Then use the ▽ key to move the cursor to the next digit.
6. Once the password has been entered, press the ▷ key to access the 'Calibration Menu'.

The password is factory set at 9990. This can be changed in Configuration Menu shown on page 18 of this manual.

4.2 Channel Configuration Menu

To view and modify the Channel Configuration settings use the following procedure. This procedure applies to the configuration of all four channels

1. When 'Channel 1 Configuration Menu' is displayed, press the ▷key to enter the menu.
2. There are 23 levels under each channel, 22 of them can be modified to suit the user's requirements.
3. By using the △ or ▽ keys, the programmer can scroll through the menu.
4. By using the ▷ key, the programmer can enter into the displayed menu or save the new settings.
5. Using the ◁ key will allow the programmer to escape out of the modify zone

4.2.1 Input Type

The first level is read only and displays the 'Input Type', which is set by the manufacture. For example; 4-20 mA or 0.4-2.0 V inputs.

4.2.2 Set Input Status

Enables Channels to be selected ON or OFF

1. To modify 'Status' press the ▷ key to enter
2. Use the △ key to toggle between ON and OFF, i.e. Channel ON or OFF
3. To save, use the ▷ key
4. To escape, use the ◁ key.

4.2.3 Set Gas Name

The controller has 6 pre-set gas types: CH_4, CO, O_2, H_2S, AV and DP. If another gas type is required the operator can select the User Function to input the desired gas type.

1. To modify 'Gas Name' press ▷ key to enter
2. Use the △ key to scroll through the Gas names
3. To save, use the ▷ key or
4. To input another Gas name, scroll to 'User' by pressing the △ key
5. Use the ▷ key to enter into 'User'
6. Enter the desired name by pressing △ key to scroll through the alpha-numerals
7. Press the ▽ key to move the cursor across to the next segment
8. Once the desired Gas name has been entered, use the ▷ key to save
9. To escape, use the ◁ key

4.2.4 Set Decimal Point

Required to set correct gas reading

1. To modify 'Dec Pt' press ▷ key to enter
2. Use the △ key to move the decimal point to the required position
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.2.5 Set Full Scale

Required to set correct gas reading

1. To modify 'FS' press ▷ to enter
2. Use the △ key to scroll through the numbers
3. Use the ▽ key to move the cursor across to the required alpha-numeral setting
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.2.6 Set Units of Measure

Required to set correct gas reading

1. To modify 'Units' press ▷ to enter
2. Use the △ key to scroll through the Units
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.2.7 Set Tag Name

Enables customer to assign a name to the controller for identification purposes

1. To modify 'Tag' press ▷ to enter
2. Use the △ key to scroll through the alpha-numerals
3. Use the ▽ key to move the cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.2.8 Setting Alarm or Fault Levels

To set alarm or fault levels use the procedure for the Low / High Fault Alarm following. The same three steps can be carried out on all alarm/faults by scrolling down the menu to the required area and inputting the correct information.

4.2.9 Set Low / High Fault Alarm Level

1. To modify 'LF' press ▷ to enter
2. Use the △ key to scroll through the numbers
3. Use the ▽ key to move the cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.2.10 Set Low / High Fault Alarm Direction

1. To modify 'LF DIR' press ▷ to enter
2. Use the △ key to toggle between Falling/Rising
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.2.11 Set Low / High Fault Alarm Latch

1. To modify 'LF Latch' press ▷ to enter
2. Use the △ key to toggle between YES and NO
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.2.12 Set Alarm Delay

1. To modify 'ALM DLY' press ▷ to enter
2. Use the △ key to scroll through the numbers
3. Use the ▽ key to move the cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.2.13 Set Alarm Hysteresis

1. To modify 'A1 HYST' press ▷ to enter
2. Use the △ key to scroll through the percentages
3. Use the ▽ key to move the cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key
6. To set A2 and A3 Hysteresis levels, recompleted steps 1 through 5

4.3 Zone Configuration Menu

To view and modify the Zone Configuration settings use the following procedure. This procedure can be applied to the configuration of all six Zones and for all four Channels.

1. Once in the Configuration Main Menu, scroll down using the ▽ key to position **5; Zone Configuration.**
2. Press ▷ to enter into sub-menu.

4.3.1 Set Zone Status

1. To Modify 'Status' press the ▷ key to enter
2. Use the △ key to toggle between ON and OFF
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.3.2 Set Zone Tag Name

1. To modify 'TAG' press the ▷ key to enter
2. Use the △ key to scroll through the alpha-numerals
3. Use the ▽ key to move the cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.3.3 Set Zone 1 to Channel 1 /Low Fault Alarm

1. To modify 'CH1 LF' press the ▷ key to enter
2. Use the △ key to toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.3.4 Set Zone 1 to Channel 1/Alarm 1

1. To modify 'CH1 A1' press the ▷ key to enter
2. Use the △ key to toggle between IN and /NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.3.5 Set Zone 1 to Channel 1/Alarm 2

1. To modify 'CH1 A2' press the ▷ key to enter
2. Use the △ key to toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.3.6 Set Zone 1 to Channel 1/Alarm 3

1. To modify 'CH1 A3' press the ▷ key to enter
2. Use the △ key to toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.3.7 Set Zone 1 to Channel 1/High Fault Alarm

1. To modify 'CH1 HF' press the ▷ key to enter
2. Use the △ key to toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.3.8 Set Voting Configuration (Refer to section 2.6.4 before setting voting functions)

1. To modify 'Voting Value' press the ▷ key to enter
2. Use the △ key to toggle between values 1 and 20
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.4 Relay Configuration Menu

To view and modify individual Relay Configuration settings use the following procedure.

1. Once in the Configuration Menu, scroll down using the ▽ key to position **11. Relay Configuration**.
2. Press ▷ to enter into sub-menu

4.4.1 Set Relay Status

1. To modify 'Status' press the ▷ key to enter
2. Use the △ key to toggle between ON and OFF
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.4.2 Set Relay Type

1. To modify 'RLY TYPE' press the ▷ key to enter
2. Use the △ key to toggle between ND/NE
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.4.3 Set Tag Name

1. To modify 'TAG' press the ▷ key to enter
2. Use the △ key to scroll through the alpha-numerals
3. Use the ▽ key to move the cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.4.4 Set Relay 1 to Zone 1

1. To modify 'ZN1' press the ▷ key to enter
2. Use the △ key to toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.4.5 Set Relay Start-Up Mode

5. To modify 'PwrUpMode' press the ▷ key to enter
6. Use the △ key to toggle between LIVE and LATCHED
7. To save, use the ▷ key
8. To escape, use the ◁ key

4.5 Output Configuration Menu

To view and modify the Output Configuration settings use the following procedure. This procedure can be applied to the configuration of all three outputs. **Note: Outputs are always 4-20mA even if the inputs are 0.4-2.0V types.**

1. Once in the Configuration Main Menu, scroll down using ▽ key to position **15 Output Configuration**
2. Press ▷ key to enter into sub-menu

4.5.1 Set Output Status

1. To modify 'Status' press the ▷key to enter
2. Use the △ key to toggle between ON and OFF
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.5.2 Set Output Tag Name

1. To modify 'Output' press the ▷ key to enter
2. Use the △ key to scroll through the alpha-numerals
3. Use the ▽ key to move cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.5.3 Set Output Type

1. To modify 'OP Type' press the ▷ key to enter
2. Use the △ key to toggle between FOLLOW, HIGHEST, and LOWEST
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.5.4 Set Output to Channel 1

1. To modify 'CH1' press the ▷ key to enter
2. Use the △ key toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.5.5 Set Output to Channel 2

1. To modify 'CH2' press the ▷ key to enter
2. Use the △ key toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.5.6 Set Output to Channel 3

1. To modify 'CH3' press the ▷ key to enter
2. Use the △ key toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.5.7 Set Output to Channel 4

1. To modify 'CH4' press the ▷ key to enter
2. Use the △ key toggle between IN and NOT IN
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.6 System Configuration Menu

1. Once in the Configuration Main Menu, scroll down using ▽ key to position **18 System Configuration**
2. Press ▷ key to enter into sub-menu

4.6.1 Configuration Version

This level is read only and displays the 'Configuration Version' set at manufacturing

4.6.2 Modbus Address

1. To modify 'Modbus Addr' press the ▷ key to enter
2. Use the △ key to increment the address from 1 to 32
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.6.3 Set Baud Rate

5. To modify 'Baud Rate' press the ▷ key to enter
6. Use the △ key to toggle between 2400, 4800, 9600, and 19.2k
7. To save, use the ▷ key
8. To escape, use the ◁ key

4.6.4 Set Parity

1. To modify 'Parity' press the ▷ key to enter
2. Use the △ key to toggle between ODD, EVEN, and NONE
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.6.5 Set Start Up Delay

1. To modify 'S DLY (sec)' press the ▷ key to enter
2. Use the △ key to scroll through the numbers
3. Use the ▽ key to move cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.6.6 Set Tag Name 1

1. To modify 'TN1' press the ▷ key to enter
2. Use the △ key to scroll through the alpha-numerals
3. Use the ▽ key to move the cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.6.7 Set Tag Name 2

1. To modify 'TN2' press the ▷ key to enter
2. Use the △ key to scroll through the alpha-numerals
3. Use the ▽ key to move the cursor across to the next digit
4. To save, use the ▷ key
5. To escape, use the ◁ key

4.6.8 Change Configuration Password

1. To modify 'Change Pass' press the ▷ key to enter
2. Use the △ key to scroll through the numbers
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.6.9 Change Fault Clear Setting

1. To modify 'Change FLT CLR' press the ▷ key to enter
2. Use the △ key to toggle between Enabled and DIsabled
3. To save, use the ▷ key
4. To escape, use the ◁ key

4.7 Calibration Menu

4.7.1 To Enter the Calibration Menu:

1. From the Monitoring Screen, press the △ key twice to scroll up to level 6 'Calibration View and Modify'
2. Press the ▷ key to enter into the 'Do you want to Continue?' screen
3. If YES, press the ▷ key to gain access, if NO, press use the ◁ key to escape
4. On the 'Enter Password' screen, use the △ key to scroll through the numbers
5. Then use the ▽ key to move the cursor to the next digit
6. Once the password has been entered, press the ▷ key to access a second password entry screen
7. Repeat the above steps to enter the password. Press the ▷ to enter the 'Calibration Menu'

To view and modify the Calibration settings use the following procedure. There are eight Levels in the Calibration Menu. These levels allow the programmer to calibrate the four channels, three outputs and the supply voltage.

To perform a supply voltage calibration, it will be necessary to connect a variable 10-16 Vdc power source.

The following instructions (4.7.2 and 4.7.3) apply to all 4 Channels.

4.7.2 Channel 1 Zero Calibration

1. Press the ▷ key to enter into 'Channel 1 Calibration'
2. Connect a calibrated 4 mA / 0.4V signal (depending on input type) to channel 1 contacts
3. The displayed value should read around zero
4. Press the ▷ key to save this calibration
5. To escape, use the ◁ key

4.7.3 Channel 1 Span Calibration

1. In 'Channel 1 Calibration', hold the △ key down for 5 seconds.
2. Connect a calibrated 20 mA / 2.0V signal (depending on input type) to channel 1 contacts
3. The displayed value should read a number above zero
4. Press the ▷ key to save this calibration
5. To escape, use the ◁ key

4.7.4 10 Volt Supply Voltage Calibration

1. To modify 'Supply Voltage Calibration' press the ▷ key to enter
2. Select 10 Volts from the 10- 16 Volt variable power supply connected across the power contacts
3. Press the ▷ key to save the calibration at 10 Volts
4. To escape, use the ◁ key

4.7.5 16 Volt Supply Voltage Calibration

1. In 'Supply Voltage Calibration', hold the △ key down for 5 seconds.
2. Select 16 Volts from the 10-16 Volt variable power supply connected across the power contacts
3. Press the ▷key to save the calibration at 16 Volts.
4. To escape, use the ◁ key

The following instructions (4.7.6 and 4.7.7) apply to all 3 outputs.

4.7.6 Output 1 Zero Calibration

1. To modify 'Output 1 Calibration' press the ▷ key to enter
2. Connect a calibrated multi-meter, set to mA, across output 1 contacts
3. The multi meter should read 4 mA, if it does not, use the △ key to increase the signal or the ▽ key to decrease the signal
4. Once the signal is reading 4 mA, press the ▷ key to save the calibration
5. To escape, use the ◁ key

4.7.7 Output 1 Span Calibration

1. In 'Output 1 Calibration' hold the △ key for 5 seconds.
2. With the multi-meter still connected, the reading should be 20 mA, if not, use the △ key to increase the signal or the ▽ key to decrease the signal
3. Once the signal is reading 20 mA, press the ▷ key to save the calibration
4. To escape, use the ◁ key.

5 Controller Installation

5.1 Ensuring Safe Installation

The Controller requires to be installed into a system along with appropriate devices providing input signals (sensors) and output control/indication (fan controls, beacons, sirens, SCADA systems etc.).
Before the Controller can be installed, there are a number of things that need to be considered and understood to prevent incorrect or unsafe operation of the Controller or the system into which it is installed.
Along with relevant competence, and an understanding of the target application, the following points should be considered:-

5.1.1 Ensure that the information provided in sections 2.3 and 2.4 is fully understood.

It is extremely important that the limitations of the controller are understood to prevent incorrect installation and use from creating a potentially dangerous risk. If in doubt as to the nature of the limitations or their implication, consult a competent authority such as a supervisor or Ampcontrol applications engineer.

5.1.2 Ensure that the information in sections 2.6 to 2.9 is understood. Specific attention should be paid to the highlighted notes regarding incorrect Controller settings.

It is extremely important that the functionality of the controller is understood to prevent incorrect configuration creating a potentially dangerous risk. If in doubt as to the nature of the limitations or their implication, consult a competent authority such as a supervisor or Ampcontrol applications engineer.

5.1.3 Ensure that the application into which the Controller is being installed has been properly defined, approved and designed.

Any system intended to mitigate the risk of injury needs to be properly designed and implemented. Such a system must be the result of structured risk analysis with the outcomes used to define the system requirements. These requirements, in turn, will guide the choice of instrumentation, logic solvers and actuators needed to implement the system. Understanding the needs of the system will ensure proper selection of equipment.

5.1.4 Ensure that the Controller will properly perform the required functions within the system design.

It is important to understand how the Controller is intended to interact with other equipment within a system. For safe and reliable use, it is crucial that neither the Controller's logical operation nor its signalling be compromised by incompatibilities with connected equipment.

5.1.5 Ensure that the intended devices to be connected to the Controller are compatible with the entity parameters as specified on the Controller's certificate of compliance (conditions of safe use).

Check the terminal parameters of all devices intended to be connected to the Controller against the Controller's certificate of conformance. If in doubt, consult a competent authority, or contact an Ampcontrol applications engineer.

CAUTION! 	**The user is responsible for maintaining the Ex ia Intrinsic Safety rating by complying with the "List of Special Conditions" outlined in the certificate (Appendix C – Approvals).**

5.2 Mounting the Controller

5.2.1 IP rating and Physical Protection

The Controller enclosure is not rated to provide either dust or water ingress protection.
To ensure that the Controller is not subjected to conditions that could cause dust or moisture to enter the enclosure, it must be mounted inside a suitable IP rated wall mounted enclosure.
Although the Controller housing is made from tough ABS, it will not provide protection against impact from heavy objects. Damage to the enclosure and internal electronics could cause malfunction, rendering the controller unsafe. Mounting the Controller in a robust, lockable enclosure will minimise the chance of physical damage.

5.2.2 Ease of Access

Mounting the Controller within an enclosure should be done in such a way as to allow full access to the connection terminals, display and buttons. Positioning of the Controller should also be such to allow easy removal of the unit for repair. The Controller should also be clearly visible to allow inspections to be carried out without having to remove parts of the installation (visual inspections)

5.3 Connecting to the Controller

Wiring of the controller and systems must be carried out with reference to standards appropriate for the application, industry and/or locale. Failure to comply with standards could lead to a dangerously installed system.

5.3.1 Entity Parameters

When connecting the Controller to other equipment, it is important that the specified parameters that apply to each Controller terminal are known and understood. It is also important to know and understand these parameters in relation to connected equipment and cables. These parameters are given on the equipment's certificate of compliance and set the maximum limits, beyond which the equipment is no longer safe to use within its hazardous area certification. These specified limits, known as 'entity parameters' inform and restrict quantities such as voltages, currents, capacitance and inductance in relation to the terminals that will be used to connect to other equipment.

Inputs will have maximum allowable voltages and currents that may be applied to them along with maximum values of capacitance and inductance that appear at these terminals resulting from internal circuitry.
Typical input parameters would be:-

Ui:	Maximum voltage that can be applied to an input terminal
Ii:	Maximum current that can be supplied to an input terminal
Ci / Li:	Maximum capacitance / inductance that 'appears' at an input terminal

Output terminals will have maximum values of voltages and currents available from them, specified under worst case conditions. Outputs also carry limitations regarding the maximum capacitance and inductance that they can connect to whilst maintaining safe operation. Output terminals may also specify the level of capacitance and inductance that appears on them as a result of internal circuitry.
Typical output parameters would be:-

Uo:	Maximum voltage available from a terminal under worst case conditions
Io:	Maximum current available from a terminal under worst case conditions
Co / Lo:	Total capacitance / inductance that can be safely connected to a terminal

Capacitance is found in connecting cables and the inputs of other equipment. When connecting equipment together, the total values of all capacitances and inductances must be taken into account and must not exceed the values specified for that connection or system total. For example, if a gas detector's output terminal has 1nF of capacitance associated with it, and can connect safely to a maximum capacitance of 10nF, any equipment and cable that is to be connected to the gas detector must have a total capacitance of no more than 9nF.

5.3.2 Type of Cable

Cables that are used to connect the Controller to other parts of a system or other equipment must be adequately rated in terms of maximum voltages and current that it can handle safely.
Cable electrical resistance, capacitance and inductance must also be taken into account in order to maintain compliance with equipment / system entity parameters (see previous section). Cables will have resistance, capacitance and inductance parameters specified per unit length. It is therefore important to take into account the cable length used in an installation in respect to the total value of these parameters.
In addition to their electrical properties, cables must afford physical protection against being damaged by impact or abrasion. This applies particularly to cables that are external to a wall cabinet that houses the Controller.
Cables may be both electrically screened against noise interference as well as sheathed in a strong wire jacket to prevent crushing. Such cables would generally also be sheathed in a material that is resistant to abrasion and attack from chemicals such as fuels.

5.3.3 Cable Termination

When connecting cables to the Controller, it is not sufficient to simply strip and twist a cable's inner conductor and insert into the Controller terminal. Stripped and twisted conductors must not be used and especially ones tinned with solder. Solder exhibits a behaviour known as 'cold-creep' and in effect would flatten under the pressure of the Controller's terminal screw. Once this happens, the connection is likely to become loose and unreliable. All connections to the Controller must be made via appropriate cable crimp connectors. The Controller's terminals can take a cable crimp of up to 2.5mm diameter.

5.3.4 Cable Marking

When making connections to the Controller, individual conductors should be marked with a cable marker or tag so that correct connections can be made across an entire system. Unmarked conductors are generally hard to have their function identified across the physical parts of a system. This could lead to potentially dangerous system operation due to mis-matched connections between equipment, as well as obvious system malfunction.

5.3.5 Cable Restraint

All connected cables that run from the Controller to other equipment must be suitable restrained to prevent stress on the controller terminals. If cables are allowed to freely hang and pull against a terminals fixing screw, then eventually the connection could fail. Such unrestrained connections could create the potential of system malfunction, resulting in the creation of a hazardous risk situation. Proper cable restraint will ensure that the potential risk of system failures due to cable breakages is minimised.

6 Controller Commissioning

Before being placed into service, the controller must be commissioned in order to validate its installation. The checking of any complete system that the Controller may be installed into, is beyond the scope of this manual. Such system wide checks must be carried out in accordance with relevant site standards and must include an instruction or reference to a procedure for commissioning the Controller.
For any system supplied that involves a controller, there will be a commissioning test form. An example of such, is Ampcontrol document No. GSB010 (a copy of this form is located in appendix A). Test forms for individual applications will contain aspects of the system that must be checked, part of which will be the Controller.

6.1 Completing a Controller Test Form (Common Header Information)

The specifics of a test form will vary, but recording the following information should be considered standard across all applications:-

Job number related to the commissioning.
Customer Name.
Location of the controller (site address and location on the site, system type, e.g. continuous miner etc.)
Product Type (Version of Controller also included).
Serial Number.
Name of person carrying out the commissioning.
Date.
References to site specific restrictions and applicable standards.

6.2 Running through a Controller Commissioning (Refer to the example test sheet in appendix A)

The actual setting that the controller must have will have been defined at either the system design phase or between the time of the Controller installation and the first power up (commissioning) phase. Although shipped with a set of default values, each individual application will requires adjustments to the configuration settings.
If configuration is to be carried out with the Controller in-situ, it may be beneficial to disconnect all relay connections and current follower connections, to prevent unwanted system interactions.

6.2.1 From first power-up, the following operations can be checked immediately:-

1. Power LED illuminates.

2. All LEDs illuminate and display indicates 'SELF TEST IN PROGRESS' **[a]**

3. After 4 seconds, display indicates 'DELAY'**[b]** in the display window for each enabled channel. Alarm and Fault LEDs extinguish. RL1, RL2, RL3 and RL4 LEDs illuminate.

4. Delay expires and display indicates channel readings. If relays have been set to LATCHED power up mode, then all relay LEDs will remain illuminated once the start-up delay expires. An alarm reset is required to clear the states of relays that start up in latched mode.

[a] The self test phase of the Controller checks the integrity of the system configurations and memory read/write integrity. If the memory check fails, the Controller will pulse all LEDs on and off and toggle the state of all four relays on a 1 second on, 1 second off cycle. If this occurs, contact Ampcontrol.

[b] The Controller start-up delay, delays the action of processing channel input signals, thereby allowing connected equipment to establish stable working conditions after power-up. During this time, the Controller's alarm relays are held in an alarm state.

6.2.2 Checking Controller Functionality

Once the configuration setting has been made, the overall Controller functionality must be verified across all of its expected operating conditions. This will typically consist of driving each active Controller input channel from a zero input signal all the way up to and beyond the channel's full scale value. During the time each channel is driven, observations, checks and measurements must be made of alarm points, relays, current repeater outputs and display values. A record of Controller test results should be recorded on the test form.
A channel may be driven either by its connected sensor, or by a device that simulates the signal from that sensor. If the sensor itself is used, then some means of stimulating it will be needed. In the case of a gas detector, this would be a cylinder of calibration gas. For other sensor types such as pressure, temperature, flow and humidity, it may be difficult to create the conditions required to drive the connected controller channel over the required range to allow proper testing. It is more convenient to simulate the output of a sensor using a device such as a loop calibrator/simulator. This device (signal simulator) provides accurately adjustable levels of voltage or current that can be injected into the Controller's input channels.

Assuming a signal simulator is used to provide channel input signals, a typical test sequence would be:-

- Connect the signal simulator to the input channel to be tested
- Set the simulator to provide zero input signal (0V or 0mA)
- Observe the display value for that channel – is it reading correctly ?
- Observe the alarm and Fault LEDs – are they correctly illuminated for the given configuration settings ?
- Measure the relay contacts with a continuity meter – are the appropriate contacts in the correct state per the configuration settings ?
- Measure the current follower outputs – are the outputs correct per the configuration settings ?
- Increase the input signal and continue the same checks as above as the signal passes through each configured alarm trip-points.
- Check for correct operation of any configured alarm delays.
- Check that latched alarms remain when the input is reduced below the alarm trigger point.
- Ensure that when powered down and back up again, the latched alarm states are re-instated.
- Ensure that following an alarm reset from the front panel (if this is enabled in the controller configuration), all alarms clear and relays reset to non-alarm state (input signal set below all alarm set-points).
- Ensure that following an alarm reset from the remote reset input, all alarms clear and relays reset to non-alarm state (input signal set below all alarm set-points).
- Check that any digital communications to other devices is working correctly (check Modbus settings and operation).

When all Controller operations have been checked and verified as working, the test record should be signed off and stored in a secure place for future reference.

7 Service, Maintenance & Disposal

7.1 Equipment Service

The Controller requires no internal servicing during its normal operating lifetime. A number of external system based checks should however be made on a regular basis. These 'routine inspections' must be carried out by suitably trained people with knowledge of the Controller and the systems into which it is fitted.
Routine inspections may take the form of either simple visual-only checks, or visual and 'hands-on' checks.

7.1.1 Visual Only Inspections

A basic visual inspection will focus on looking at the installation for signs of physical damage, water or dust ingress as well as the condition of cables and labels. This type of inspection may involve opening cabinets to gain access to the Controller and other equipment. This level of inspection may also include cleaning display windows that have become obscured by dirt.

NOTE: The Controller's enclosure and display window must only be cleaned using anti-static cleaning materials. Do not clean the Controller with any cleaning products that may cause the build-up of static charge.

Observations would typically be:

- Check that equipment enclosures, cable trays, conduits, wall-boxes etc. are in good order with no physical damage
- Check that sealed wall-boxes are free from water and dust ingress internally. Door seals are in good condition.
- Check that connected cables are free from cuts, abrasions and obvious signs of damage. Cable restraints are in good order and correctly fitted.
- Check that labels on equipment, wall boxes and cables are present and in good clean condition (especially certification labels)
- Check that no modifications have been carried out to installed equipment.

7.1.2 Hand-On (Detailed) Inspections

A more detailed inspection would include all of the elements of a visual inspection, plus some checks that cover the integrity of connections, fixtures and fittings.

In addition to basic visual observations, more detailed integrity checks would involve:

- Verify that equipment housings, wall boxes and other mechanical fixtures are secured tightly in place. This includes the lids of terminal boxes, tightness of cable glands, integrity of wall-box mountings, security of equipment fixing to walls / DIN rails etc.
- Verify all electrical connections are secure with no loose screw terminals or DIN rail terminals not fitted to rails etc.

7.2 Equipment Maintenance

WARNING! 	**The Gasguard Controller has no user serviceable parts. All repairs must be carried out by Ampcontrol personnel only. If a fault develops return the Controller to Ampcontrol for repair. It is essential that no attempt be made to repair the Controller as any attempt to dismantle or repair the Controller can seriously compromise the safety of the unit and the consequence can be fatal.**

The Ampcontrol Gasguard Controller does not have any customer serviceable parts and is not provided with any user adjustments.

7.3 Disposal of System Parts

	The electronic equipment discussed in this manual must not be treated as general waste. By ensuring that this product is disposed of correctly you will be helping to prevent potentially negative consequences for the environment and human health which could otherwise be caused by incorrect waste handling of this product.

8 Equipment List

105232 Four Channel IS Controller
105231 Two Channel IS Controller
120875 Gasguard User Manual

9 Specifications

Voltage:

10 to 16.5 VDC (Nominal 12 V IS Supply)

Input Channels:

Four channels
4/20 mA or 0.4 – 2 V (Set during manufacture)
For 4-20mA input type, input resistance is 100 Ohms between channel input and channel -.

Relay Outputs:

Four IS Relay Outputs – Can be configured:-
Normally Energised (NE)
Normally De-energised (ND)
Latched (L) / Non-Latched (NL).

Contacts:

1 C/O. Rated at 2 A, 30 Vdc (Resistive).
Relay contacts are considered as isolated intrinsically safe circuits. See certificate of conformance for details.

Repeat outputs:

Three 4/20 mA programmable outputs. (Applies to both 4-20mA and 0.4-2.0V input controller types).
Maximum 300 Ohm load with 12V dc supply. See performance graph in Appendix A (A6).

Set-points:

3 programmable set-points per channel, Hysteresis adjustable 0-20% of channel scale
2 programmable fault set-points per channel . No hysteresis.

Alarm Reset:

Volt-Free switch or relay contact input.
Front panel left key (press and hold). Selectable in configuration settings to be enabled or disabled.

Communications:

RS485 Modbus RTU - Slave only.

LED Indication:

There are seven (7) Status LED's located on the facia

Power LED - (Red)
Alarm LED – (Red)
Fault LED – (Red)
Four Relay state Indication LED's – (Red).

Dimensions (mm):

Overall: 75H x 100W x 110D

10 Data Communication Specification

Communication Port: RS485

Protocol: Standard Modbus Protocol – RTU Mode

Baud rate: 2400, 4800, 9600, 19200 bps. Parity: Even, Odd, None, Data bits: 8, Modbus Slave Address: 1- 32

10.1 Modbus Memory Map Part 1

10.1.1 Memory Type 0:

Modbus Address	Description	Data Format
00001	Relay 1 Status	1 → Relay is Active 0 → Relay is Normal
00002	Relay 2 Status	
00003	Relay 3 Status	
00004	Relay 4 Status	

Available Modbus Function code is 0x01 (Read Coil Status).

10.1.2 Memory Type 1:

Modbus Address	Description	Data Format
10001	Channel 1 Low Fault	1 → Fault /Alarm State 0 → Normal
10002	Channel 1 Alarm 1	
10003	Channel 1 Alarm 2	
10004	Channel 1 Alarm 3	
10005	Channel 1 High Fault	
10006	Channel 1 Spare	
10007	Channel 1 Spare	
10008	Channel 1 Spare	
10009	Channel 2 Low Fault	
10010	Channel 2 Alarm 1	
10011	Channel 2 Alarm 2	
10012	Channel 2 Alarm 3	
10013	Channel 2 High Fault	
10014	Channel 2 Spare	
10015	Channel 2 Spare	
10016	Channel 2 Spare	
10017	Channel 3 Low Fault	
10018	Channel 3 Alarm 1	
10019	Channel 3 Alarm 2	
10020	Channel 3 Alarm 3	1 → Fault /Alarm State 0 → Normal
10021	Channel 3 High Fault	
10022	Channel 3 Spare	
10023	Channel 3 Spare	
10024	Channel 3 Spare	
10025	Channel 4 Low Fault	
10026	Channel 4 Alarm 1	
10027	Channel 4 Alarm 2	
10028	Channel 4 Alarm 3	
10029	Channel 4 High Fault	
10030	Channel 4 Spare	
10031	Channel 4 Spare	
10032	Channel 4 Spare	
10033	Zone 1 Status	1 → Zone Active 0 → Zone Normal
10034	Zone 2 Status	
10035	Zone 3 Status	
10036	Zone 4 Status	
10037	Zone 5 Status	
10038	Zone 6 Status	

Available Modbus function code is 0x02 (Read Input Status)

10.1.3 Memory Type 3:

Modbus Address	Description	Data Format
30001	Channel 1 Analogue Input	Normalize Values: 4mA ➔ 4000 20mA → 20000
30002	Channel 2 Analogue Input	
30003	Channel 3 Analogue Input	
30004	Channel 4 Analogue Input	
30005	Channel 1 Analogue Input	Value as displayed with decimal point removed.
30006	Channel 2 Analogue Input	
30007	Channel 3 Analogue Input	
30008	Channel 4 Analogue Input	
30009	Channel 1 Display Format Value	Possible Values are: 1 10 100 1000
30010	Channel 2 Display Format Value	Same as for Channel 1
30011	Channel 3 Display Format Value	Same as for Channel 1
30012	Channel 4 Display Format Value	Same as for Channel 1
30013	Supply Voltage Register	Voltage in millivolts. Example:- 11058 = 11,058mV (11.058V)

Available Modbus function code is 0x04 (Read Input Registers)

10.1.4 Memory Type 4:

Modbus Address	Description	Data Format
40001	Channel 1 Set-point LF	Normalize Values: 4mA → 4000 20mA → 20000
40002	Channel 1 Set-point A1	
40003	Channel 1 Set-point A2	
40004	Channel 1 Set-point A3	
40005	Channel 2 Set-point HF	
40006	Channel 2 Set-point LF	
40007	Channel 2 Set-point A1	Normalize Values: 4mA → 4000 20mA → 20000
40008	Channel 2 Set-point A2	
40009	Channel 2 Set-point A3	
40010	Channel 2 Set-point HF	
40011	Channel 3 Set-point LF	
40012	Channel 3 Set-point A1	
40013	Channel 3 Set-point A2	
40014	Channel 3 Set-point A3	
40015	Channel 3 Set-point HF	
40016	Channel 4 Set-point LF	
40017	Channel 4 Set-point A1	
40018	Channel 4 Set-point A2	
40019	Channel 4 Set-point A3	
40020	Channel 4 Set-point HF	
40021	Channel 1 Set-point A1	Value as displayed with decimal point removed.
40022	Channel 1 Set-point A2	
40023	Channel 1 Set-point A3	
40024	Channel 2 Set-point A1	
40025	Channel 2 Set-point A2	
40026	Channel 2 Set-point A3	
40027	Channel 3 Set-point A1	
40028	Channel 3 Set-point A2	
40029	Channel 3 Set-point A3	
40030	Channel 4 Set-point A1	
40031	Channel 4 Set-point A2	
40032	Channel 4 Set-point A3	
40033	Channel 1 Display Format Value	Possible Values are: 1 10 100 1000
40034	Channel 2 Display Format Value	
40035	Channel 3 Display Format Value	
40036	Channel 4 Display Format Value	
40037	Channel 1 Display Full Scale	Value as displayed with decimal point removed. Value Range: 0 - 9999
40038	Channel 2 Display Full Scale	
40039	Channel 3 Display Full Scale	
40040	Channel 4 Display Full Scale	
40041	Channel 1 Alarm Direction	Bit0 = LF Bit1 = A1 Bit2 = A2 Bit3 = A3 Bit4 = HF Bit5 – Bit15 = N/A 1 → Raising 0 → Falling
40042	Channel 2 Alarm Direction	
40043	Channel 3 Alarm Direction	
40044	Channel 4 Alarm Direction	
40045	Channel 1 Alarm Latch	Bit0 = LF Bit1 = A1 Bit2 = A2 Bit3 = A3 Bit4 = HF Bit5 – Bit15 = N/A 1 → Latch On 0 → Latch Off
40046	Channel 2 Alarm Latch	
40047	Channel 3 Alarm Latch	
40048	Channel 4 Alarm Latch	

40049	Channel 1 Alarm Delay	Value in mSec. Value Range: 0 - 9999
40050	Channel 2 Alarm Delay	
40051	Channel 3 Alarm Delay	
40052	Channel 4 Alarm Delay	
40053	Channel 1 Control	Bit0 –Bit5 = N/A Bit6 = Hide (1→ On , 0→ Off) Bit7 = Status (1→ Off, 0→ On) Bit8 – Bit15 = N/A
40054	Channel 2 Control	
40055	Channel 3 Control	
40056	Channel 4 Control	
40057	Channel 1 Gas Name	Value Range: 1 = CH4 2 = CO 3 = O2 4 = H2S 5 = AV(Air Velocity) 6 = DP(Diff.Pressure) 255 = User
40058	Channel 2 Gas Name	
40059	Channel 3 Gas Name	
40060	Channel 4 Gas Name	
40061	Zone 1 Control	Bit0 – Bit5 = N/A Bit6 = Hide (1→ On , 0→ Off) Bit7 = Status (1→ Off, 0→ On) Bit8- Bit15 = N/A
40062	Zone 2 Control	
40063	Zone 3 Control	
40064	Zone 4 Control	
40065	Zone 5 Control	
40066	Zone 6 Control	
40067	Zone 1 To Ch1 Ch2 Alarms	Bit0 = Ch 1 LF Bit1 = Ch 1 A1 Bit2 = Ch1 A2 Bit3 = Ch1 A3 Bit4 = Ch1 HF Bit5- Bit7 = N/A Bit8 = Ch2 LF Bit9 = Ch 2 A1 Bit10 = Ch2 A2 Bit11 = Ch2 A3 Bit12 = Ch2 HF Bit13- Bit15 = N/A 1 → Selected 0 → Not Selected
40068	Zone 1 To Ch3 Ch4 Alarms	
40069	Zone 2 To Ch1 Ch2 Alarms	
40070	Zone 2 To Ch3 Ch4 Alarms	
40071	Zone 3 To Ch1 Ch2 Alarms	
40072	Zone 3 To Ch3 Ch4 Alarms	
40073	Zone 4 To Ch1 Ch2 Alarms	
40074	Zone 4 To Ch3 Ch4 Alarms	
40075	Zone 5 To Ch1 Ch2 Alarms	
40076	Zone 5 To Ch3 Ch4 Alarms	
40075	Zone 6 To Ch1 Ch2 Alarms	
40076	Zone 6 To Ch3 Ch4 Alarms	
40077	Zone 1 Voting Number	Value Range: 1 - 20
40078	Zone 2 Voting Number	
40079	Zone 3 Voting Number	
40080	Zone 4 Voting Number	
40081	Zone 5 Voting Number	
40082	Zone 6 Voting Number	
40083	Relay 1 Control	Bit0 = Mode (1=NE, 0= ND) Bit1- Bit5 = N/A Bit6 = Hide (1→ On , 0→ Off) Bit7 = Status (1→ Off , 0→ On) Bit8- Bit15 = N/A
40084	Relay 2 Control	
40085	Relay 3 Control	
40086	Relay 4 Control	
40087	Relay 1 To Zone Map	Bit0 = Zone 1 Bit1 = Zone 2 Bit2 = Zone 3 Bit3 = Zone 4 Bit4 = Zone 5 Bit5 = Zone 6 Bit6-Bit15 = N/A 1 → Selected 0 → Not Selected
40088	Relay 2 To Zone Map	
40089	Relay 3 To Zone Map	
40090	Relay 4 To Zone Map	

40091	Output 1 Control	Bit0 – Bit2 = Function (0= Follow, 1=Highest, 2=Lowest) Bit3-Bit5 = N/A Bit6 = Hide (1→ On , 0→ Off) Bit7 = Status (1→ Off , 0→ On) Bit8- Bit15 = N/A
40092	Output 2 Control	
40093	Output 3 Control	
40094	Output 1 To Channel Map	Bit0 = Channel 1 Bit1 = Channel 2 Bit2 = Channel 3 Bit3 = Channel 4 Bit4- Bit15 = N/A 1 → Selected 0 → Not Selected
40095	Output 2 To Channel Map	
40096	Output 3 To Channel Map	
40096	Output 3 To Channel Map	

Available Modbus function code is 0x03 (Read Holding Registers)
Note: If there is any other information needed, it can be added to the Modbus Address map

10.2 Modbus Memory Map Part 2

Data Words in Sim-G Module

Word 1 1 = Alarm 0 = OK

10016	10015	10014	10013	10012	10011	10010	10009	10008	10007	10006	10005	10004	10003	10002	10001
Channel 2 Not Used	Channel 2 Not Used	Channel 2 Not Used	Channel 2 High Fault	Channel 2 Alarm 3	Channel 2 Alarm 2	Channel 2 Alarm 1	Channel 2 Low Fault	Channel 1 Not Used	Channel 1 Not Used	Channel 1 Not Used	Channel 1 High Fault	Channel 1 Alarm 3	Channel 1 Alarm 2	Channel 1 Alarm 1	Channel 1 Low Fault

Word 2 1 = Alarm 0 = OK

10032	10031	10030	10029	10028	10027	10026	10025	10024	10023	10022	10021	10020	10019	10018	10017
Channel 4 Not Used	Channel 4 Not Used	Channel 4 Not Used	Channel 4 High Fault	Channel 4 Alarm 3	Channel 4 Alarm 2	Channel 4 Alarm 1	Channel 4 Low Fault	Channel 3 Not Used	Channel 3 Not Used	Channel 3 Not Used	Channel 3 High Fault	Channel 3 Alarm 3	Channel 3 Alarm 2	Channel 3 Alarm 1	Channel 3 Low Fault

Word 3 Not Used

Word 4 1 = Active 0 = Normal

						10038	10037	10036	10035	10034	10033	00004	00003	00002	00001
RS 485 Comm Status 1 = Error	Not Used	Not Used	Not Used	Not Used	Not Used	Zone 6 Status	Zone 5 Status	Zone 4 Status	Zone 3 Status	Zone 2 Status	Zone 1 Status	Relay 4 Status	Relay 3 Status	Relay 2 Status	Relay 1 Status

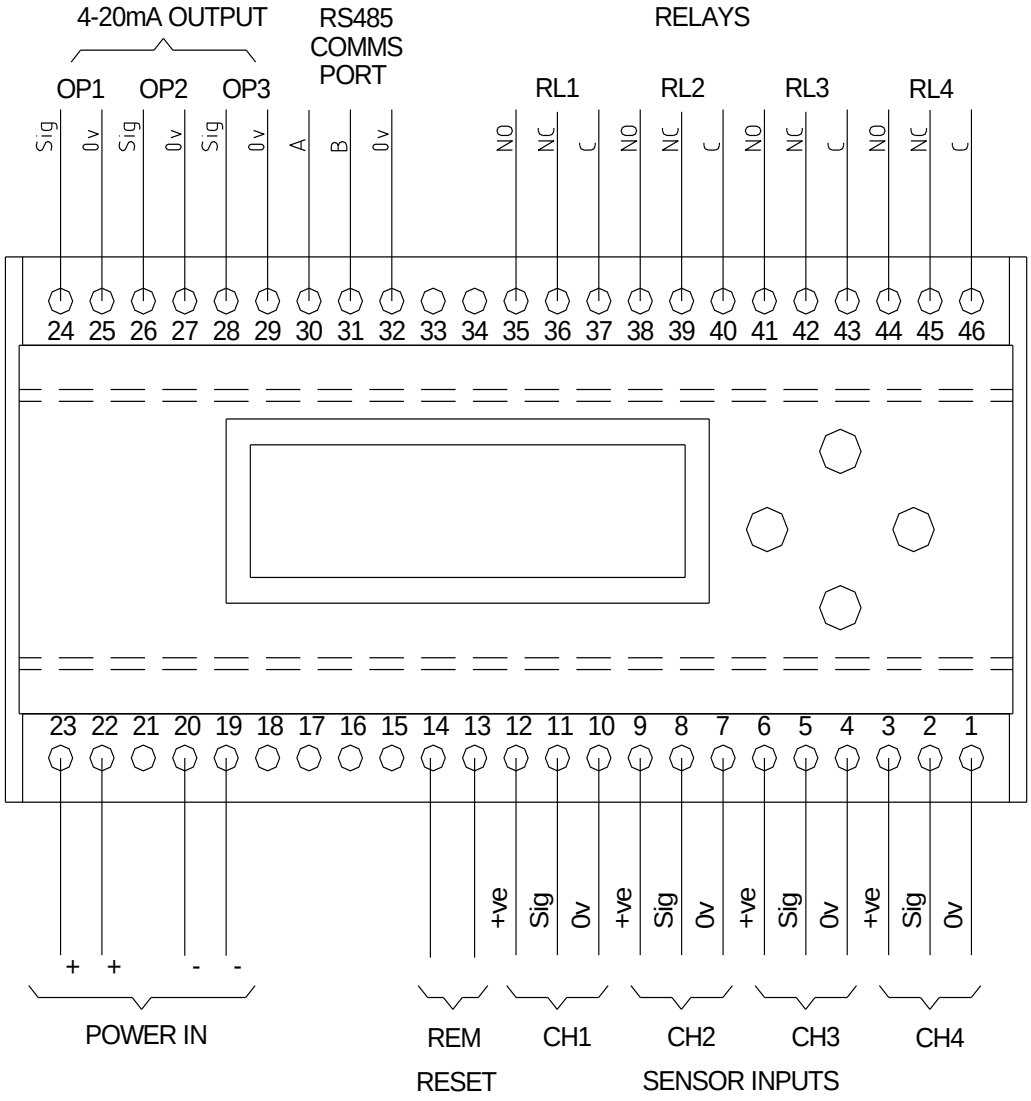
Word 5	30005	Channel 1 Analogue Input (Values as displayed on per Gasguard Controller Display with Decimal point removed) 0 - 9999
Word 6	30006	Channel 2 Analogue Input (Values as displayed on per Gasguard Controller Display with Decimal point removed) 0 - 9999
Word 7	30007	Channel 3 Analogue Input (Values as displayed on per Gasguard Controller Display with Decimal point removed) 0 - 9999
Word 8	30008	Channel 4 Analogue Input (Values as displayed on per Gasguard Controller Display with Decimal point removed) 0 - 9999
Word 9	30009	Channel 1 Display Format Value (Possible Values are: 1, 10, 100, 1000)
Word 10	30010	Channel 2 Display Format Value (Possible Values are: 1, 10, 100, 1000)
Word 11	30011	Channel 3 Display Format Value (Possible Values are: 1, 10, 100, 1000)
Word 12	30012	Channel 4 Display Format Value (Possible Values are: 1, 10, 100, 1000)
Word 13		Not Used
Word 14		Not Used
Word 15	N/A	Error Count for RS 485 Communication
Word 16	N/A	SIM-G Serial Number

Configuration Words in Sim-G Module

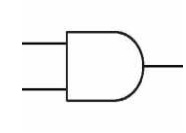
Block Number	Gasguard Modbus Address	Description
0		SIM Address
		Gasguard Controller Modbus Slave Address
		Not Used
		Not Used
1	40021	Channel 1 Alarm 1 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40022	Channel 1 Alarm 2 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40023	Channel 1 Alarm 3 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40024	Channel 2 Alarm 1 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
2	40025	Channel 2 Alarm 2 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40026	Channel 2 Alarm 3 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40027	Channel 3 Alarm 1 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40028	Channel 3 Alarm 2 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
3	40029	Channel 3 Alarm 3 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40030	Channel 4 Alarm 1 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40031	Channel 4 Alarm 2 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
	40032	Channel 4 Alarm 3 Setpoint (Value as displayed on per Gasguard Controller Display with Decimal point removed)
4	40033	Channel 1 Display Format Value (Possible Values are: 1, 10, 100, 1000)
	40034	Channel 2 Display Format Value (Possible Values are: 1, 10, 100, 1000)
	40035	Channel 3 Display Format Value (Possible Values are: 1, 10, 100, 1000)
	40036	Channel 4 Display Format Value (Possible Values are: 1, 10, 100, 1000)

Appendix A

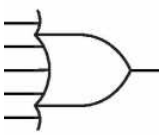
A1: Connection Diagram



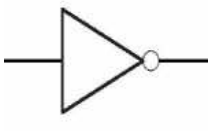
System Functional Block Diagrams – Key to Symbols.



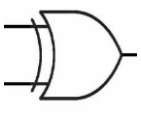
LOGICAL AND



LOGICAL OR

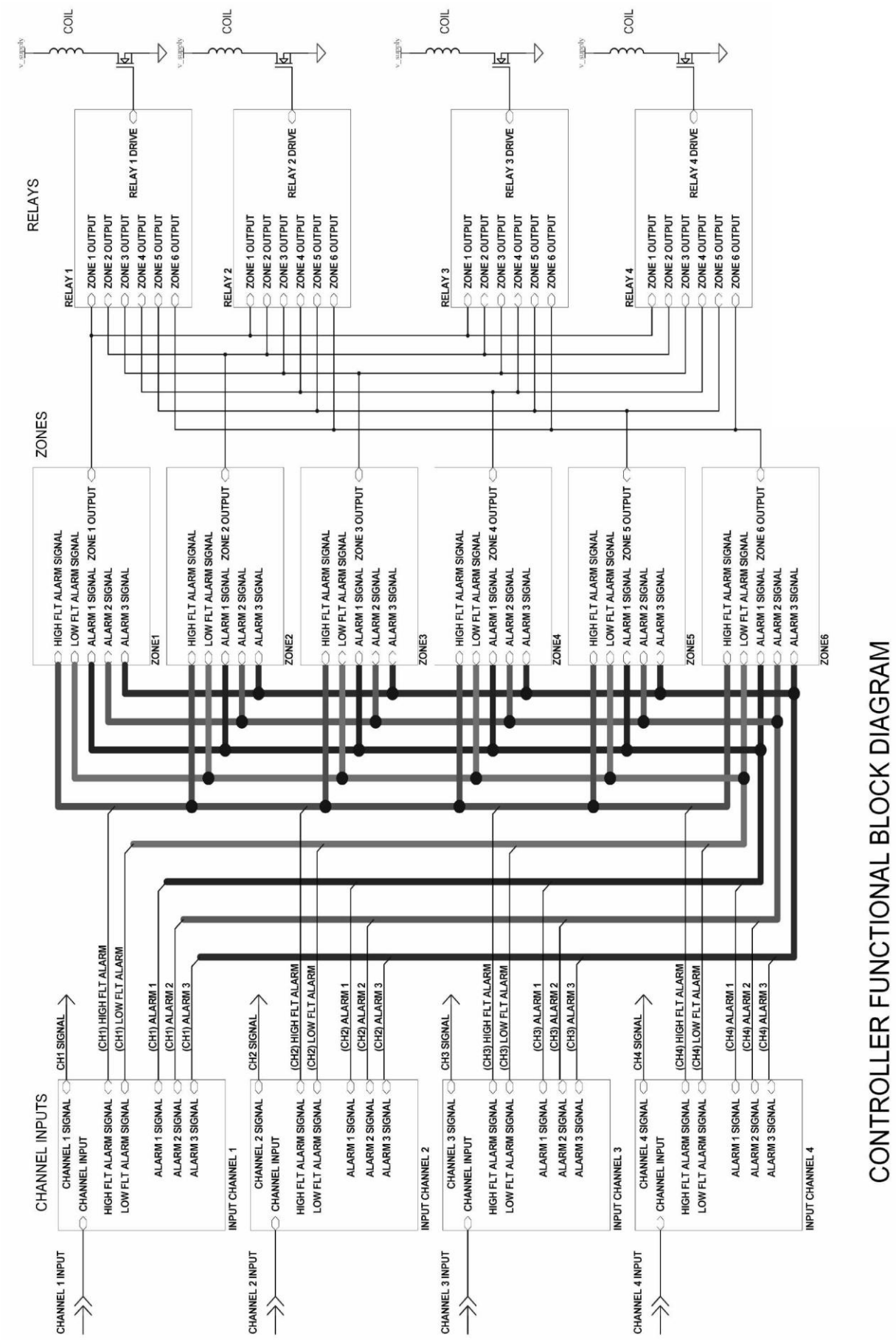


LOGICAL INVERSION

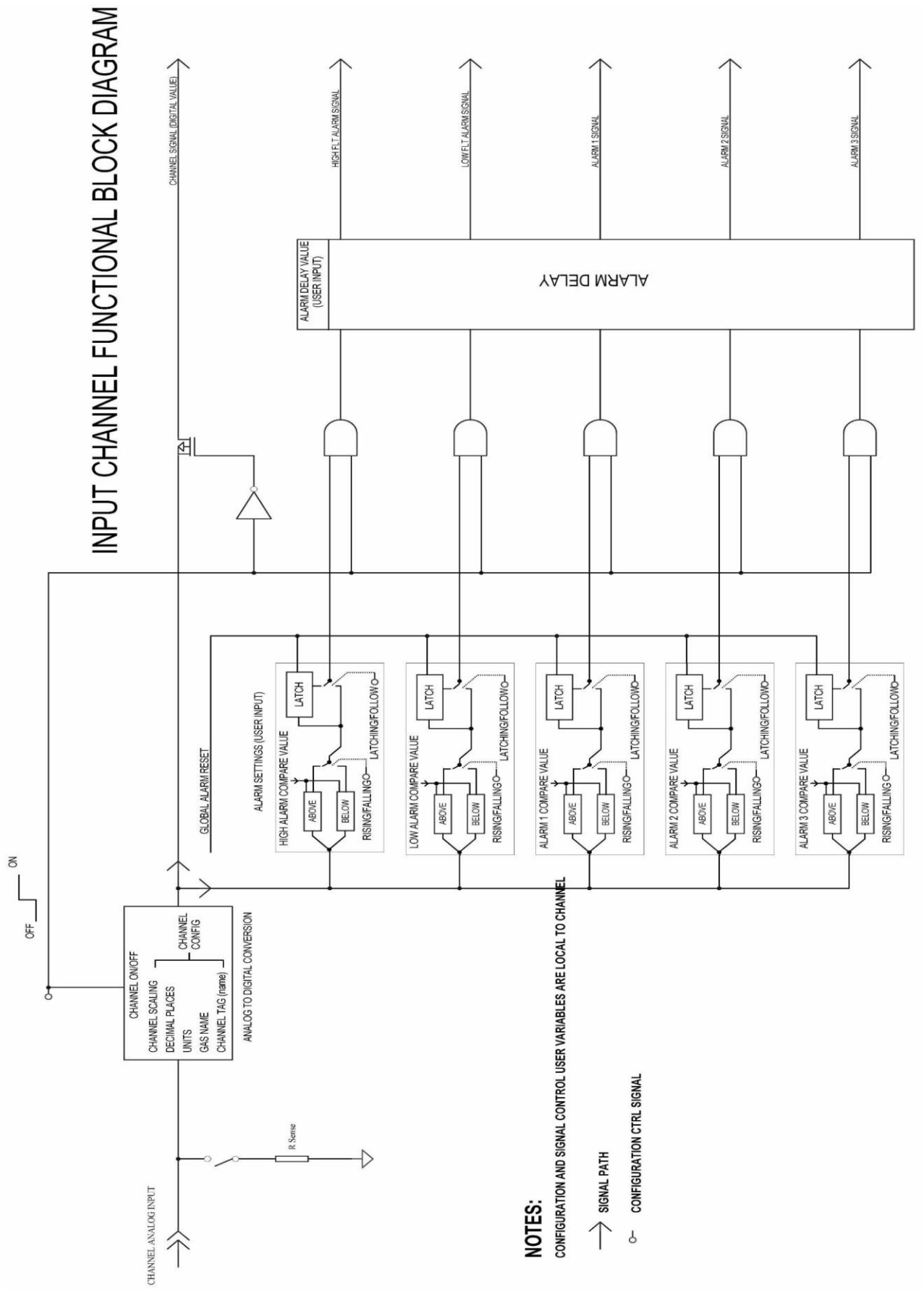


LOGICAL EXLUSIVE OR

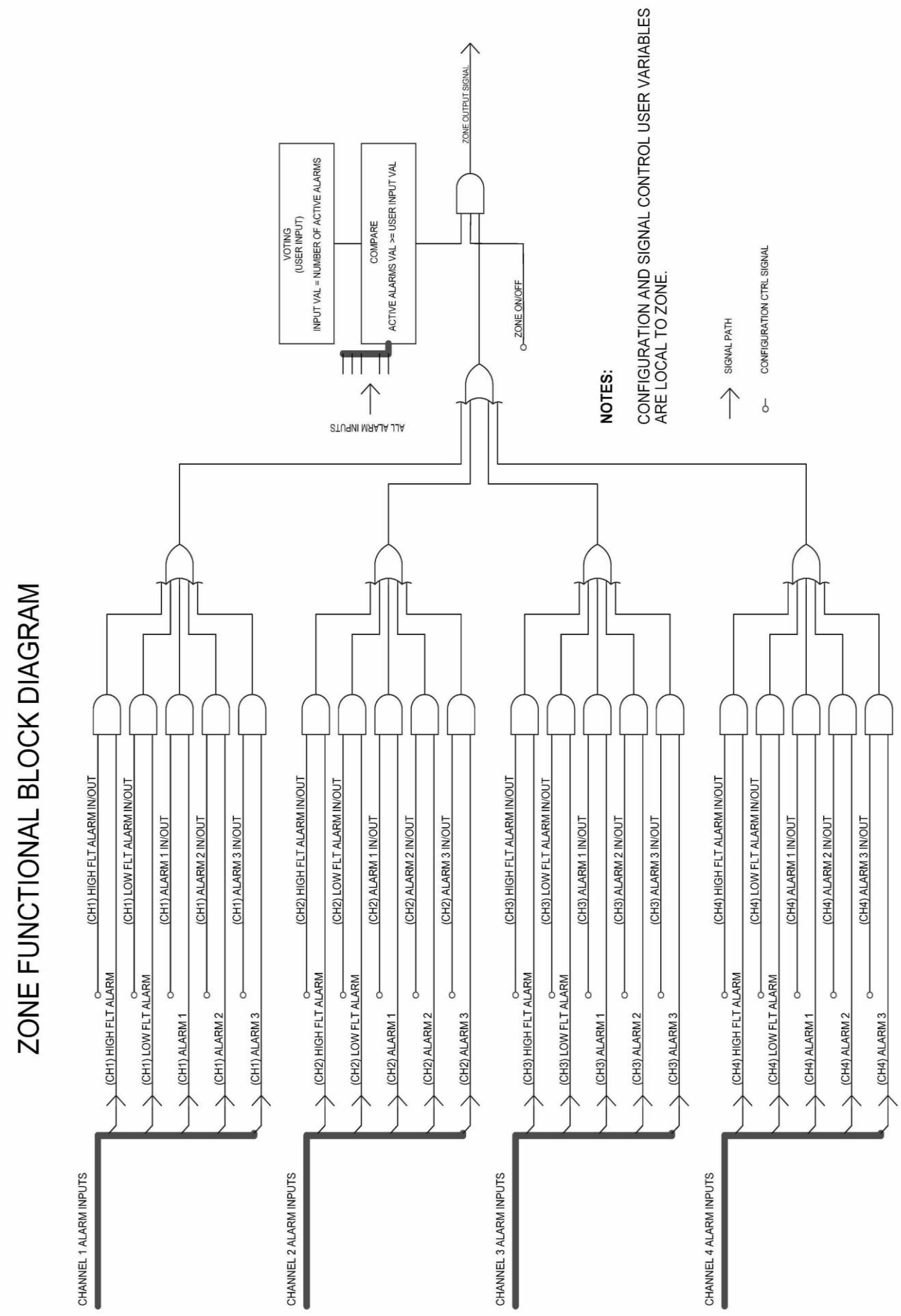
A2: Top Level Functional Block Diagram



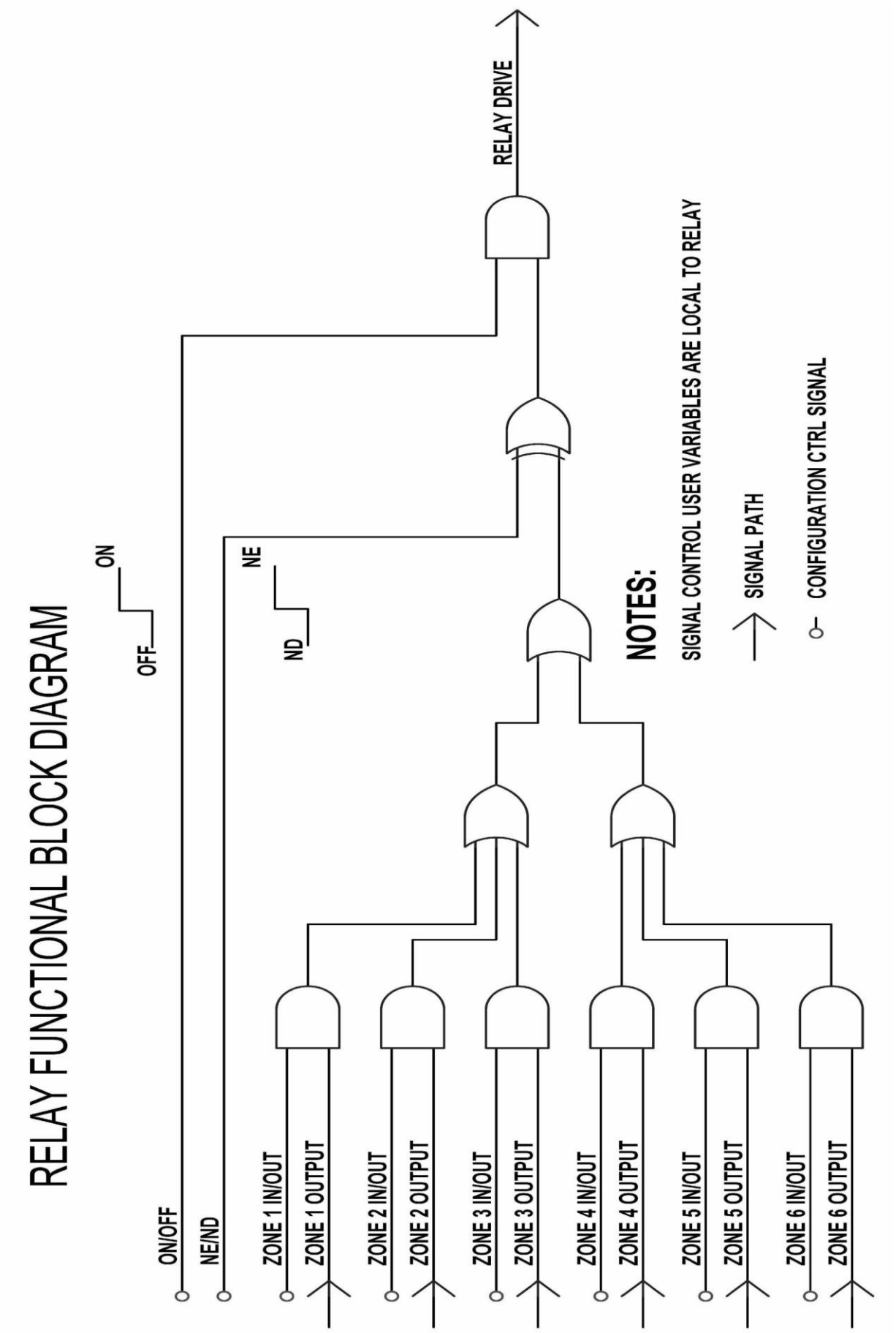
A3: Input Channel Functional Block Diagram



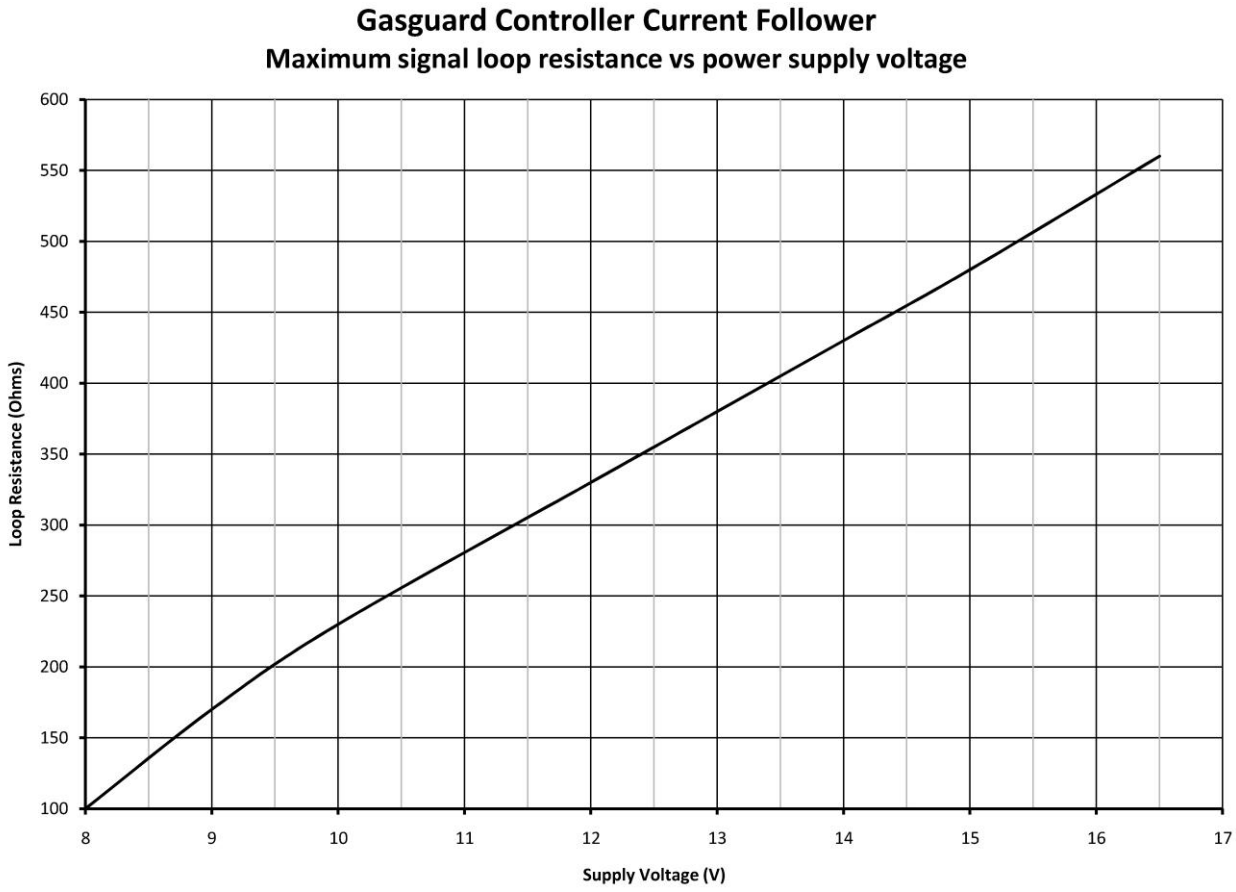
A4: Zoning Functional Block Diagram



A5: Relay Functional Block Diagram



A6: Current Follower Outputs - Performance Graph.



A7: Sample Commissioning Test Form.

The sample test form shows a set of values for a typical system. In a practical application, these values will depend on the specific controller type and how the configuration has been set.

AMPCONTROL®

GAS STATION - TEST REPORT

Customer:			
P/O No:		**Job No:**	
Type:		**Date:**	

Controller Serial Number								
Labels fitted	☐							
Control wiring checked	☐							
Unit powered up successfully	☐							
With 110V applied, battery charge LED on (UPS only)	☐							
Check 12V supply								
	CH1	CH2	CH3	CH4				
Check 12/15V to output terminal strip								
SIM Module is communicating with iMAC (if fitted)	☐							

Relay Configuration		
Relay 1	Normally De-energised	☐ Verified
Relay 2	Normally De-energised	☐ Verified
Relay 3	Normally Energised	☐ Verified
Relay 4	Normally Energised	☐ Verified

AMPCONTROL®

Channel 1	**Gas**	CH4	Range	5% v/v		Verified	mA / V	Engineering Value
Sensor Input Type	4-20mA	☐	Apply minimum range to channel, zero if necessary			☐	4mA	0.00 (-0.02 – 0.02)
Channel Delay	1s Delay	☐	Apply maximum to channel, adjust span if required			☐	20mA	5.00 (4.95 – 5.05)

	Programmed Setpoint	Test Values						Relays				
		Engineering Value	V		Action		iMAC Operation	1	2	3	4	
Low Fault	2mA	2.0mA		Falling	Latching	Fault LED	☐	☒	☒	☐	☒	Programmed Values
		(1.98 - 2.02)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 1	1.00%	7.2mA		Rising	Non-Latching	Alarm LED	☐	☐	☒	☐	☐	Programmed Values
		(7.13 -7.27)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 2	1.50%	8.8mA		Rising	Non-Latching	Alarm LED	☐	☐	☐	☒	☐	Programmed Values
		(8.71 - 8.89)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 3	2.00%	10.4mA		Rising	Latching	Alarm LED	☐	☒	☐	☐	☒	Programmed Values
		(10.3 - 10.5)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
High Fault	22mA	22mA		Rising	Latching	Fault LED	☐	☒	☒	☐	☒	Programmed Values
		(21.8 – 22.2)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test

AMPCONTROL®

Channel 2		**Gas**	CH4	Range	5% v/v		Verified	mA / V	Engineering Value
	Sensor Input Type	4-20mA	☐	Apply minimum range to channel, zero if necessary			☐	4.0mA	0.00 (-0.02 – 0.02)
	Channel Delay	1s Delay	☐	Apply maximum to channel, adjust span if required			☐	20.0mA	5.00 (4.95 – 5.05)

	Programmed Setpoint	Test Values						Relays				
		Engineering Value	V		Action		iMAC Operation	1	2	3	4	
Low Fault	2mA	2.0mA		Falling	Latching	Fault LED	☐	☒	☒	☐	☒	Programmed Values
		(1.98 - 2.02)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 1	1.00%	7.2mA		Rising	Non-Latching	Alarm LED	☐	☐	☒	☐	☐	Programmed Values
		(7.13 -7.27)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 2	1.50%	8.8mA		Rising	Non-Latching	Alarm LED	☐	☐	☐	☒	☐	Programmed Values
		(8.71 - 8.89)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 3	2.00%	10.4mA		Rising	Latching	Alarm LED	☐	☒	☐	☐	☒	Programmed Values
		(10.3 - 10.5)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
High Fault	22mA	22mA		Rising	Latching	Fault LED	☐	☒	☒	☐	☒	Programmed Values
		(21.8 – 22.2)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test

Channel 3		**Gas**	CH4	Range	5% v/v		Verified	mA / V	Engineering Value
	Sensor Input Type	4-20mA	☐	Apply minimum range to channel, zero if necessary			☐	4.0mA	0.00 (-0.02 – 0.02)
	Channel Delay	1s Delay	☐	Apply maximum to channel, adjust span if required			☐	20.0mA	5.00 (4.95 – 5.05)

	Programmed Setpoint	Test Values						Relays				
		Engineering Value	V		Action		iMAC Operation	1	2	3	4	
Low Fault	2mA	2.0mA		Falling	Latching	Fault LED	☐	☒	☒	☐	☒	Programmed Values
		(1.98 - 2.02)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 1	1.00%	7.2mA		Rising	Non-Latching	Alarm LED	☐	☐	☒	☐	☐	Programmed Values
		(7.13 -7.27)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 2	1.50%	8.8mA		Rising	Non-Latching	Alarm LED	☐	☐	☐	☒	☐	Programmed Values
		(8.71 - 8.89)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 3	2.00%	10.4mA		Rising	Latching	Alarm LED	☐	☒	☐	☐	☒	Programmed Values
		(10.3 - 10.5)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
High Fault	22mA	22mA		Rising	Latching	Fault LED	☐	☒	☒	☐	☒	Programmed Values
		(21.8 – 22.2)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test

Channel 4		**Gas**	CH4	Range	5% v/v		Verified	mA / V	Engineering Value
	Sensor Input Type	4-20mA	☐	Apply minimum range to channel, zero if necessary			☐	4.0mA	0.00 (-0.02 – 0.02)
	Channel Delay	1s Delay	☐	Apply maximum to channel, adjust span if required			☐	20.0mA	5.00 (4.95 – 5.05)

	Programmed Setpoint	Test Values						Relays				
		Engineering Value	V		Action		iMAC Operation	1	2	3	4	
Low Fault	2mA	2.0mA		Falling	Latching	Fault LED	☐	☒	☒	☐	☒	Programmed Values
		(1.98 - 2.02)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 1	1.00%	7.2mA		Rising	Non-Latching	Alarm LED	☐	☐	☒	☐	☐	Programmed Values
		(7.13 -7.27)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 2	1.50%	8.8mA		Rising	Non-Latching	Alarm LED	☐	☐	☐	☒	☐	Programmed Values
		(8.71 - 8.89)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
Alarm 3	2.00%	10.4mA		Rising	Latching	Alarm LED	☐	☒	☐	☐	☒	Programmed Values
		(10.3 - 10.5)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test
High Fault	22mA	22mA		Rising	Latching	Fault LED	☐	☒	☒	☐	☒	Programmed Values
		(21.8 – 22.2)		☐	☐	☐	☐	☐	☐	☐	☐	Verified on Test

Output Configuration						
	Output 1		Output 2		Output 3	
Status	OFF	☐ Verified	OFF	☐ Verified	ON	☐ Verified
Tag					IDA-VALUE	☐ Verified
Output Type					HIGHEST	☐ Verified
Channel 1.					IN	☐ Verified
Channel 2.					IN	☐ Verified
Channel 3.					OUT	☐ Verified
Channel 4.					OUT	☐ Verified

Tested By:				**Date:**									

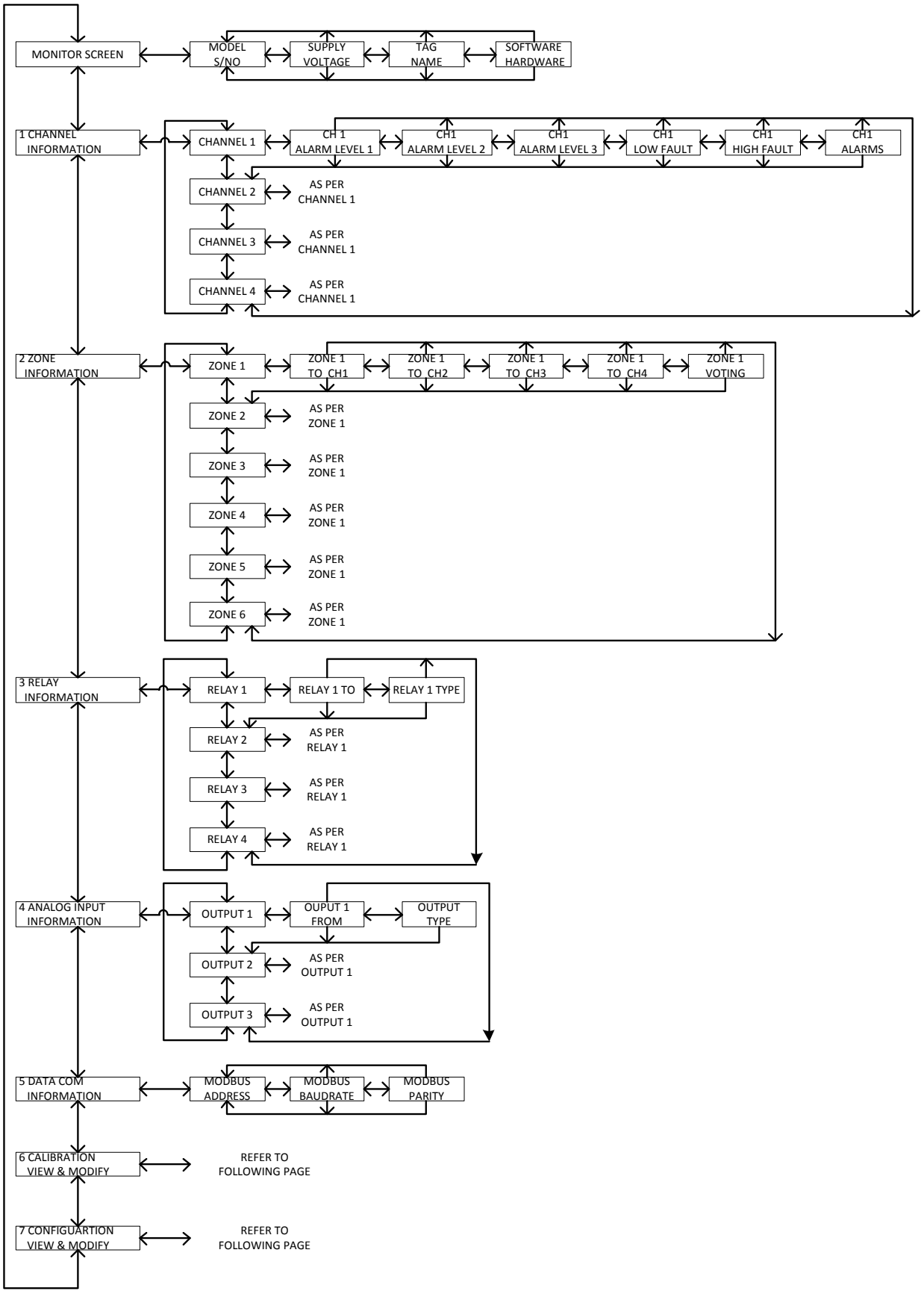
Appendix B – System Flow Chart

B1: Flow Chart Legend

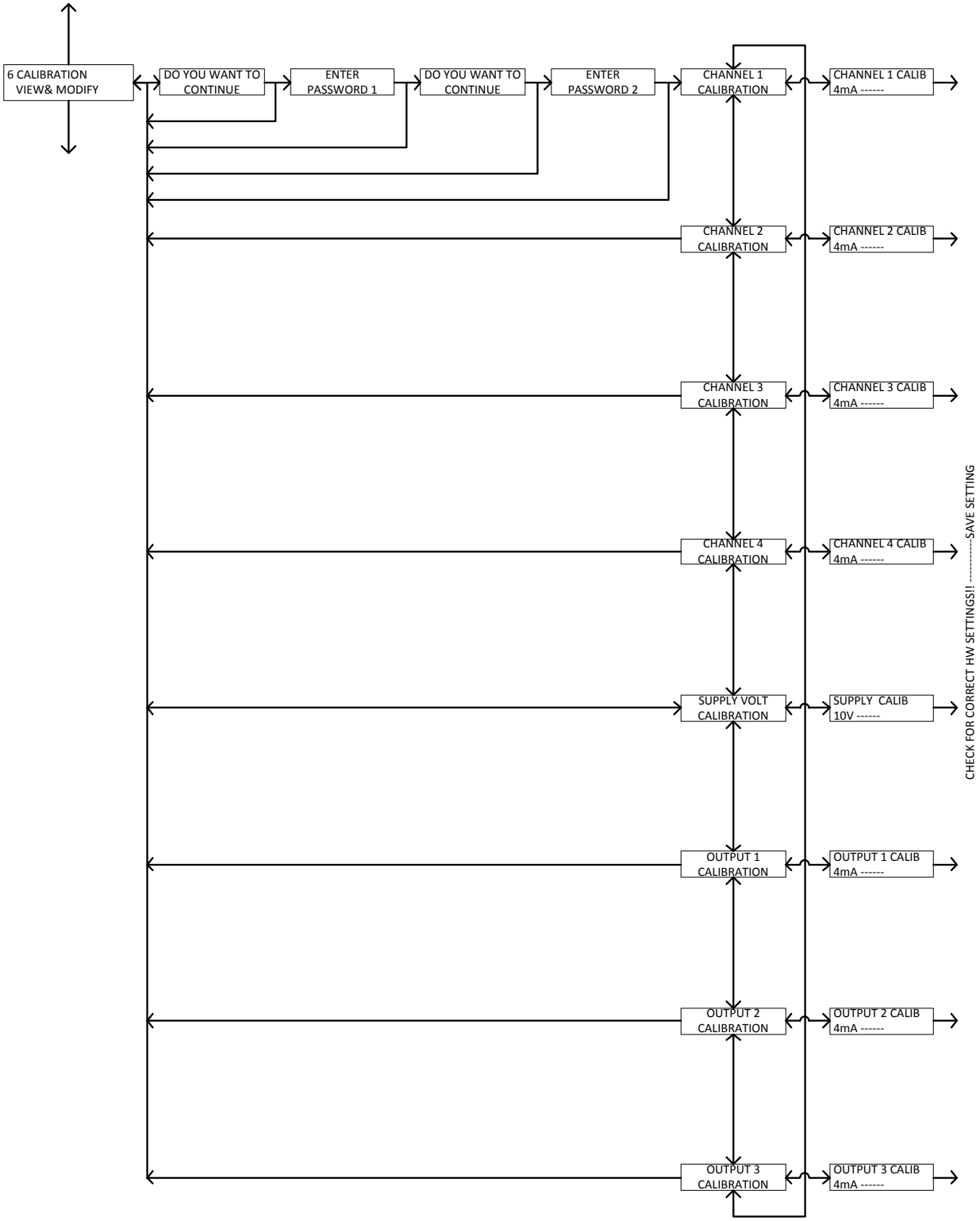
LEGEND

A : 4-20mA / 0.4-2 V
B : ON / OFF
C : O2 /H2S /AV/BP/USER /CH4/CO
D : nnnn/nnn/nn.n/n.nn
E : Numerical value
F : Hz /KHz/(m/s)/ (%v/v)/ppm/LEL/%/V/mV/rpm
G: Character
H: YES/NO
I : Rising/Falling
J : IN/NOT IN
K: ND/NE
L : Follow/Highest/Lowest
M: None/Odd/Even
N: Enabled/Disabled
O: Live/Latch

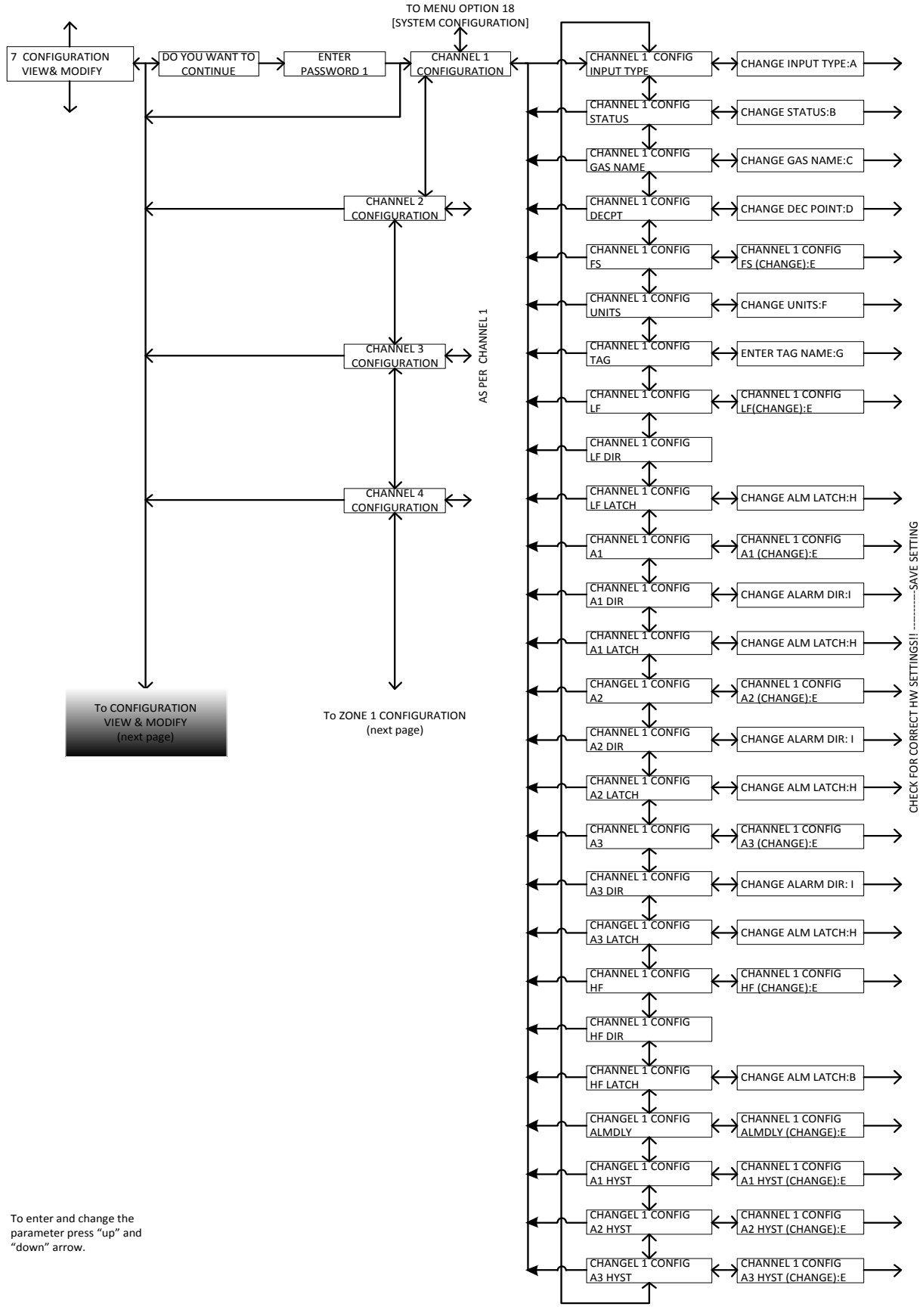
B2: Main Menu Flowchart



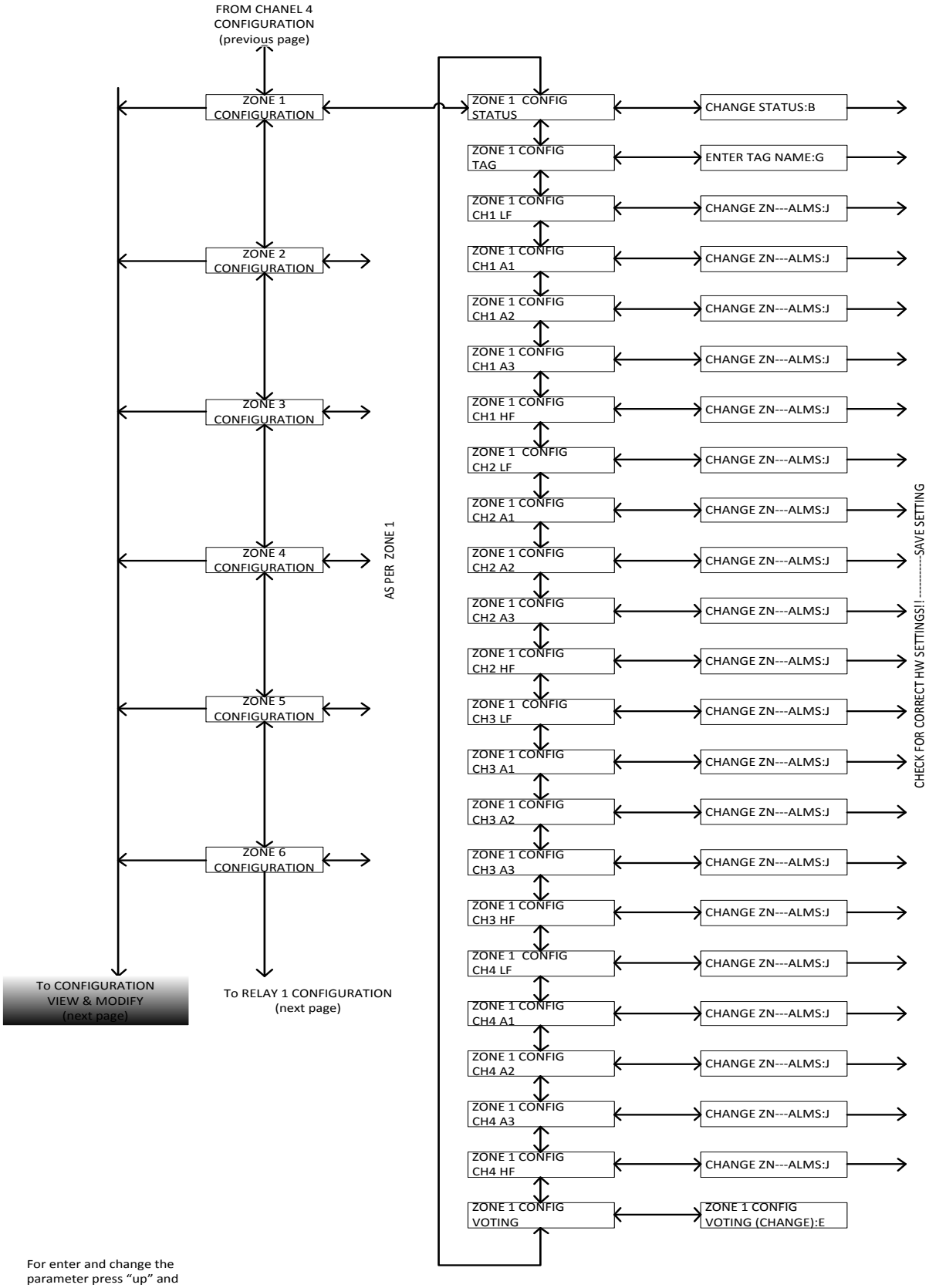
B3: Calibration Flowchart



B4: Configuration Flowchart

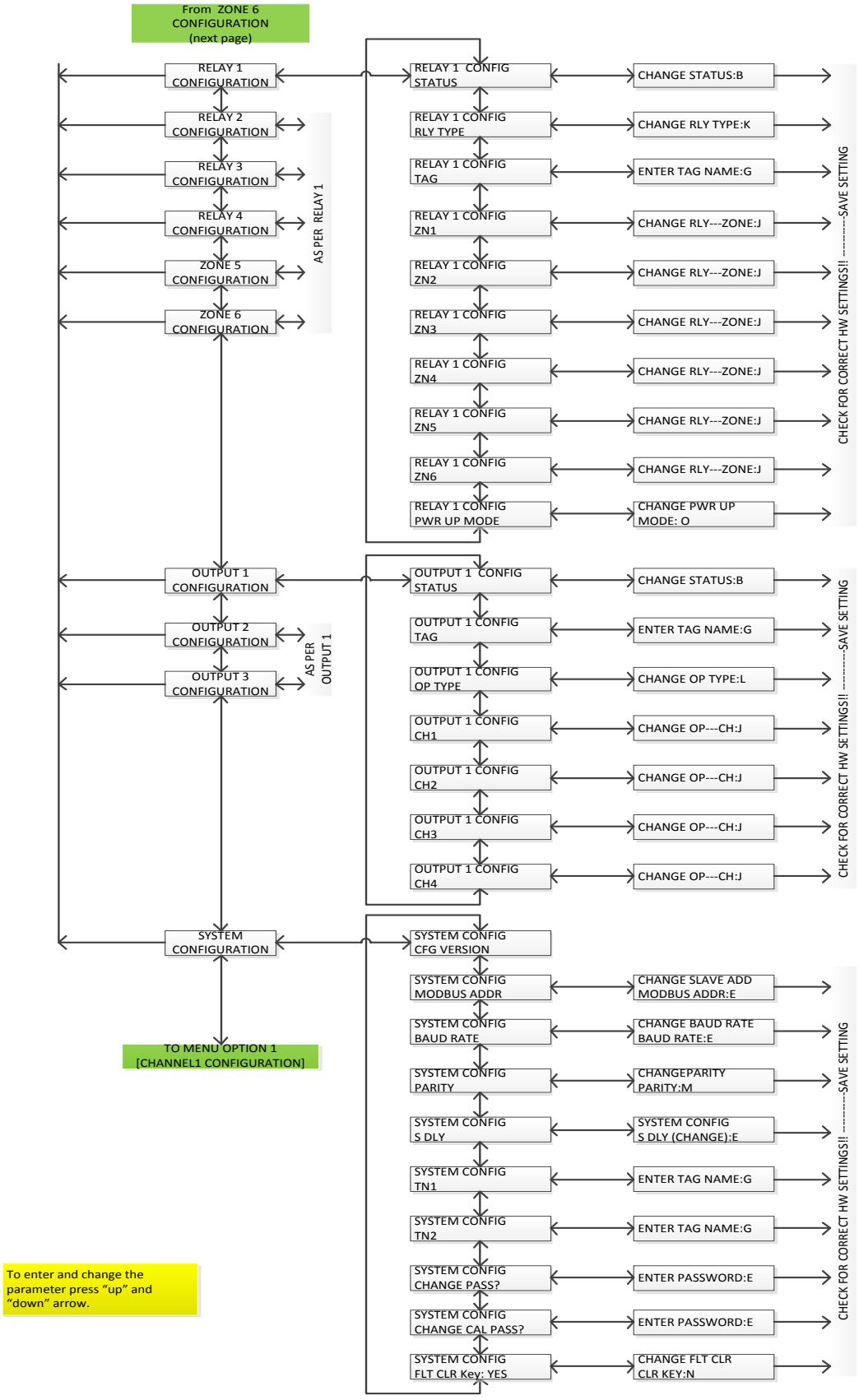


Configuration Flowchart (con't)



For enter and change the parameter press "up" and "down" arrow.

Configuration Flowchart (con't)



B5: System Default Table

CHANNEL INFORMATION

CHANNEL 1	DEFAULT PARAMETER
INPUT TYPE	4-20mA
STATUS	ON
GAS NAME	CH4
DECPT	5.00 %v/v
FS	5.00 %v/v
UNIT	%v/v
TAG	CHAN 1
LF	02.00mA
LF DIR	FALLING
LF LATCH	NO
A1	1.00 %v/v
A1 DIR	RISING
A1 LATCH	NO
A2	1.25 %v/v
A2 DIR	RISING
A2 LATCH	NO
A3	1.50 %v/v
A3 DIR	RISING
A3 LATCH	NO
HF	23.00mA
HF DIR	RISING
HF LATCH	NO
ALMDLY	1000mS
A1 HYST	5%
A2 HYST	5%
A3 HYST	5%

CHANNEL 2	DEFAULT PARAMETER
INPUT TYPE	4-20mA
STATUS	ON
GAS NAME	O2
DECPT	25.00 %v/v
FS	25.00 %v/v
UNIT	%v/v
TAG	CHAN 2
LF	02.00mA
LF DIR	FALLING
LF LATCH	NO
A1	19.5 %v/v
A1 DIR	FALLING
A1 LATCH	NO
A2	22.0 %v/v
A2 DIR	RISING
A2 LATCH	NO
A3	25.0 %v/v
A3 DIR	RISING
A3 LATCH	NO
HF	23.00mA
HF DIR	RISING
HF LATCH	NO
ALMDLY	1000mS
A1 HYST	5%
A2 HYST	5%
A3 HYST	5%

CHANNEL 3	DEFAULT PARAMETER
INPUT TYPE	4-20mA
STATUS	ON
GAS NAME	CO
DECPT	50.00 ppm
FS	50.00 ppm
UNIT	ppm
TAG	CHAN 3
LF	02.00mA
LF DIR	FALLING
LF LATCH	NO
A1	10.00 ppm
A1 DIR	RISING
A1 LATCH	YES
A2	20.00 ppm
A2 DIR	RISING
A2 LATCH	YES
A3	30.00 ppm
A3 DIR	RISING
A3 LATCH	NO
HF	23.00mA
HF DIR	RISING
HF LATCH	NO
ALMDLY	1000mS
A1 HYST	5%
A2 HYST	5%
A3 HYST	5%

CHANNEL 4	DEFAULT PARAMETER
INPUT TYPE	4-20mA
STATUS	ON
GAS NAME	CO2
DECPT	5.00 %v/v
FS	5.00 %v/v
UNIT	%v/v
TAG	CHAN 4
LF	02.00mA
LF DIR	FALLING
LF LATCH	NO
A1	1.00 %v/v
A1 DIR	RISING
A1 LATCH	NO
A2	1.50 %v/v
A2 DIR	RISING
A2 LATCH	NO
A3	2.00 %v/v
A3 DIR	RISING
A3 LATCH	NO
HF	23.00mA
HF DIR	RISING
HF LATCH	NO
ALMDLY	1000mS
A1 HYST	5%
A2 HYST	5%
A3 HYST	5%

ZONE INFORMATION

ZONE 1	DEFAULT PARAMETER
STATUS	ON
TAG	ZONE 1
CH1 LF	NOT IN
CH1 A1	IN
CH1 A2	NOT IN
CH1 A3	NOT IN
CH1 HF	NOT IN
CH2 LF	NOT IN
CH2 A1	NOT IN
CH2 A2	NOT IN
CH2 A3	NOT IN
CH2 HF	NOT IN
CH3 LF	NOT IN
CH3 A1	NOT IN
CH3 A2	NOT IN
CH3 A3	NOT IN
CH3 HF	NOT IN
CH4 LF	NOT IN
CH4 A1	NOT IN
CH4 A2	NOT IN
CH4 A3	NOT IN
CH4 HF	NOT IN
VOTING	1

ZONE 2	DEFAULT PARAMETER
STATUS	ON
TAG	ZONE 2
CH1 LF	NOT IN
CH1 A1	NOT IN
CH1 A2	IN
CH1 A3	NOT IN
CH1 HF	NOT IN
CH2 LF	NOT IN
CH2 A1	NOT IN
CH2 A2	NOT IN
CH2 A3	NOT IN
CH2 HF	NOT IN
CH3 LF	NOT IN
CH3 A1	NOT IN
CH3 A2	NOT IN
CH3 A3	NOT IN
CH3 HF	NOT IN
CH4 LF	NOT IN
CH4 A1	NOT IN
CH4 A2	NOT IN
CH4 A3	NOT IN
CH4 HF	NOT IN
VOTING	1

ZONE 3	DEFAULT PARAMETER
STATUS	ON
TAG	ZONE 3
CH1 LF	NOT IN
CH1 A1	NOT IN
CH1 A2	NOT IN
CH1 A3	IN
CH1 HF	NOT IN
CH2 LF	NOT IN
CH2 A1	NOT IN
CH2 A2	NOT IN
CH2 A3	NOT IN
CH2 HF	NOT IN
CH3 LF	NOT IN
CH3 A1	NOT IN
CH3 A2	NOT IN
CH3 A3	NOT IN
CH3 HF	NOT IN
CH4 LF	NOT IN
CH4 A1	NOT IN
CH4 A2	NOT IN
CH4 A3	NOT IN
CH4 HF	NOT IN
VOTING	1

ZONE 4	DEFAULT PARAMETER
STATUS	ON
TAG	ZONE 4
CH1 LF	NOT IN
CH1 A1	NOT IN
CH1 A2	NOT IN
CH1 A3	NOT IN
CH1 HF	NOT IN
CH2 LF	NOT IN
CH2 A1	IN
CH2 A2	NOT IN
CH2 A3	NOT IN
CH2 HF	NOT IN
CH3 LF	NOT IN
CH3 A1	NOT IN
CH3 A2	NOT IN
CH3 A3	NOT IN
CH3 HF	NOT IN
CH4 LF	NOT IN
CH4 A1	NOT IN
CH4 A2	NOT IN
CH4 A3	NOT IN
CH4 HF	NOT IN
VOTING	1

ZONE 5	DEFAULT PARAMETER
STATUS	OFF
TAG	ZONE 5
CH1 LF	NOT IN
CH1 A1	NOT IN
CH1 A2	NOT IN
CH1 A3	NOT IN
CH1 HF	NOT IN
CH2 LF	NOT IN
CH2 A1	NOT IN
CH2 A2	NOT IN
CH2 A3	NOT IN
CH2 HF	NOT IN
CH3 LF	NOT IN
CH3 A1	NOT IN
CH3 A2	NOT IN
CH3 A3	NOT IN
CH3 HF	NOT IN
CH4 LF	NOT IN
CH4 A1	NOT IN
CH4 A2	NOT IN
CH4 A3	NOT IN
CH4 HF	NOT IN
VOTING	1

ZONE 6	DEFAULT PARAMETER
STATUS	ON
TAG	ZONE 6
CH1 LF	NOT IN
CH1 A1	NOT IN
CH1 A2	NOT IN
CH1 A3	NOT IN
CH1 HF	NOT IN
CH2 LF	NOT IN
CH2 A1	NOT IN
CH2 A2	NOT IN
CH2 A3	NOT IN
CH2 HF	NOT IN
CH3 LF	NOT IN
CH3 A1	NOT IN
CH3 A2	NOT IN
CH3 A3	NOT IN
CH3 HF	NOT IN
CH4 LF	NOT IN
CH4 A1	NOT IN
CH4 A2	NOT IN
CH4 A3	NOT IN
CH4 HF	NOT IN
VOTING	1

RELAY INFORMATION

RELAY 1	DEFAULT PARAMETER
STATUS	ON
RLY TYPE	ND
TAG	RELAY 1
ZN1	IN
ZN2	NOT IN
ZN3	NOT IN
ZN4	NOT IN
ZN5	NOT IN
ZN6	NOT IN

RELAY 2	DEFAULT PARAMETER
STATUS	ON
RLY TYPE	ND
TAG	RELAY 2
ZN1	NOT IN
ZN2	IN
ZN3	NOT IN
ZN4	NOT IN
ZN5	NOT IN
ZN6	NOT IN

RELAY 3	DEFAULT PARAMETER
STATUS	ON
RLY TYPE	ND
TAG	RELAY 3
ZN1	NOT IN
ZN2	NOT IN
ZN3	IN
ZN4	NOT IN
ZN5	NOT IN
ZN6	NOT IN

RELAY 4	DEFAULT PARAMETER
STATUS	ON
RLY TYPE	ND
TAG	RELAY 4
ZN1	NOT IN
ZN2	NOT IN
ZN3	NOT IN
ZN4	IN
ZN5	NOT IN
ZN6	NOT IN

OUTPUT INFORMATION

OUTPUT 1	DEFAULT PARAMETER
STATUS	ON
TAG	OUTPUT 1
OP TYPE	FOLLOW
CH1	IN
CH2	NOT IN
CH3	NOT IN
CH4	NOT IN

OUTPUT 2	DEFAULT PARAMETER
STATUS	ON
TAG	OUTPUT 2
OP TYPE	FOLLOW
CH1	NOT IN
CH2	IN
CH3	NOT IN
CH4	NOT IN

OUTPUT 3	DEFAULT PARAMETER
STATUS	ON
TAG	OUTPUT 3
OP TYPE	FOLLOW
CH1	NOT IN
CH2	NOT IN
CH3	IN
CH4	NOT IN

SYSTEM CONFIGURATION

SYSTEM CONFIGURATION	DEFAULT PARAMETER
CFG VERSION	1
MODBUS ADDR	1
BAUD RATE	9600
PARITY	NONE
S DLY	10
TN 1	TAG NAME LINE
TN 2	TAG NAME LINE
CHANGE PASS	9999
CHANGE CAL PASS	9999
FLT CLR KEY	YES

Appendix C – Approvals

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres
for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.:	IECEx ITA 07.0003X	Issue No.:0	Certificate history:
Status:	**Current**		
Date of Issue:	**2007-05-29**	Page 1 of 3	

Applicant: **AmpControl Pty Ltd**
250 Macquarie Road, Warners Bay, New South Wales, 2282
Australia

Electrical Apparatus: **Gasguard Controller 72-6501**
Optional accessory:

Type of Protection: **Ex ia**

Marking: **Ex ia I**
IECEx ITA 07.0003X

Approved for issue on behalf of the IECEx Certification Body: David Gray

Position: Certification Authority

Signature:
(for printed version) _____

Date: _____

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website.

Certificate issued by:
International Testing and Certification Services Pty. Ltd
4 - 6 Second Street
Bowden SA 5007
Australia

ITACS

IECEx Certificate of Conformity

Certificate No.: IECExITA 07.0003X

Date of Issue: **2007-05-29** Issue No.: **0**

Manufacturer: **Austech Instruments**
Unit 1, 8 Ponderosa Parade, Warriewood, New South Wales, 2102
Australia

Manufacturing location(s):

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:
The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2004 Edition: 4.0	Electrical apparatus for explosive gas atmospheres - Part 0: General requirements
IEC 60079-11 : 2006 Edition: 5	Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"

*This Certificate **does not** indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.*

TEST & ASSESSMENT REPORTS:
A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in

Test Report:

AUTA/ExTR07.0006/00

Quality Assessment Report:

AUTA/QAR06.0002/00

IECEx Certificate of Conformity

Certificate No.: IECEx ITA 07.0003X

Date of Issue: **2007-05-29** Issue No.: **0**

Page 3 of 3

Schedule

EQUIPMENT:
Equipment and systems covered by this certificate are as follows:

The Gasguard Controller model 72-6501 is designed to provide a visual warning of the status of alarms. The alarm signals are provided by external signals.
The apparatus comprises of four printed wiring boards upon which are mounted electronic components including a liquid crystal display which are enclosed in a plastic enclosure fitted with terminal blocks for the connection of external circuits.
Refer to attachment for Manufactuer's Drawings List and Special Conditions.

CONDITIONS OF CERTIFICATION: YES as shown below

Refer to Attachment for list of Special Conditions.

ATTACHMENT TO CERTIFICATE: IECEx ITA 07.0003X
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Manufacturer's Documents:

Title:	Drawing No.:	Rev. Level:	Date:
FUSE, INTRINSICALLY SAFE GENERAL ARRANGEMENT	23-5503L-01	5	2007/01/31
LABEL 1-23 CONTROLLER TERMINALS MANUFACTURING DETAILS	29-6552L	1	2004/06/03
LABEL GASGUARD CONTROLLER OUTPUT BOARD MANUFACTURING DETAILS	29-6553L	1	2005/07/08
LABEL OVERLAY CONTROLLER ARTWORK & MANUFACTURING DETAILS	29-6501L-01	1	2007/04/04
CONTROLLER 4 CHANNEL GENERAL LAYOUT & CONNECTION DIAGRAM	75-6553L-01	4	2003/10/28
Controller Display / Switch (Top Overlay)	24-6554L-V2.PCB	V2	2004/05/28
Controller Display / Switch (TopLayer)	24-6554L-V2.PCB	V2	2004/05/28
Controller Display / Switch (BottomLayer)	24-6554L-V2.PCB	V2	2004/05/28
Controller Display / Switch (Bottom Overlay)	24-6554L-V2.PCB	V2	2004/05/28
CONTROLLER DISPLAY	75-6554L Sheet 2 of 2	V2A	2004/04/28
Controller Output (Top Overlay)	24-6553L-V2.PCB	V2	2004/05/27
Controller Output (TopLayer)	24-6553L-V2.PCB	V2	2004/05/27
Controller Output (BottomLayer)	24-6553L-V2.PCB	V2	2004/05/27
Controller Output (Bottom Overlay)	24-6553L-V2.PCB	V2	2004/05/27
Output Circuits	75-6553L Sheet 2	V3	2005/09/07
Output Circuits	75-6553L Sheet 3	V4	2007/03/27
Comms Output	75-6553L Sheet 4	V3	2005/09/07
Controller CPU (Top Overlay)	24-6552L-V3.PCB	V3	2004/05/27
Controller CPU (TopLayer)	24-6552L-V3.PCB	V3	2004/05/27

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Title:	Drawing No.:	Rev. Level:	Date:
Controller CPU (BottomLayer)	24-6552L-V3.PCB	V3	2004/05/27
Controller CPU (Bottom Overlay)	24-6552L-V3.PCB	V3	2004/05/27
Input Circuits	75-6552L Sheet 2	V4	2005/09/07
Power supply	75-6552L Sheets 3 & 4	V3	2005/09/07
Power supply	75-6552L Sheet 5	V4	2005/09/07
GASGUARD CONTROLLER RELAY BOARD IEC VERSION	75-6559L	1	2007/03/27
Gasguard Controller Relay Board IEC Version Bottom Trace	24-6559L-V1-BT	V1	2007/03/16
Gasguard Controller Relay Board IEC Version Top Overlay	24-6559L-V1-TO	V1	2007/03/16
Gasguard Controller Relay Board IEC Version Top Trace	24-6559L-V1	V1	2007/03/16

CONDITIONS:

The following list of **Special Conditions** apply to this certificate:

1. The following input parameters are to be taken in to account;

Terminals 1 to 23		
U_i =	16.5	V
I_i =	3.0	A
C_i =	52.2	nF
L_i =	negligible	µH

Terminals 24 to 33		
U_i =	16.5	V
I_i =	3.0	A
C_i =	175	nF
L_i =	negligible	µH

Terminals 33 to 46		
U_i =	16.5	V
I_i =	3.0	A
C_i =	negligible	nF
L_i =	negligible	µH

The combined total capacitance and either the combined total inductance or the inductance to resistance (L/R) ratio of the circuits connected to the Gasguard Controller Model 72-6501 terminals 1 to 32 must not exceed those specified in the Certificate for the power supply that power the system.

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2. The apparatus is considered as having the following output parameters;

Terminals 24 to 28		
U_o =	16.5	V
I_o =	878	mA
P_o=	2.99	W
C_i =	36.3	nF
L_i =	negligible	µH

Terminals 29 to 32		
U_o =	7.08	V
I_o =	56	mA
P_o=	231	mW
C_i =	2.2	nF
L_i =	negligible	µH

Terminals 33 to 46		
U_o =	0	V
I_o =	0	mA
P_o=	0	mW
C_i =	negligible	nF
L_i =	negligible	µH

The capacitance and either the inductance or the inductance to resistance (L/R) ratio of the circuits connected to the Gasguard Controller Model 72-6501 terminals 33 to 46 must not exceed those specified in the Certificate for the power supply that power the system.

Note: The above load parameters apply where:
a. The external circuit contains no combined lumped inductance Li and capacitance Ci greater than 1% of the above values. or
b. The inductance and capacitance are distributed as in a cable. or
c. The external circuit contains only lumped inductance or only lumped capacitance in combination with a cable.

In all other situations, e.g. the external circuit contains combined lumped inductance and capacitance, up to 50% of each of the inductance and capacitance values is allowed.

3. The Gasguard Controller Model 72-6501 is to be housed in an enclosure suitable for Group I that offers an ingress protection of not less than IP54 in accordance with IEC 60529.

4. Connections for programming purposes shall be effected in a non hazardous area only.
